FATIGUE AND EFFICIENCY

GOLDMARK

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FATIGUE AND EFFICIENCY

A STUDY IN INDUSTRY

By

JOSEPHINE GOLDMARK

PUBLICATION SECRETARY NATIONAL CONSUMERS' LEAGUE

INTRODUCTION

By Frederic S. Lee, Ph.D.

NEW YORK

RUSSELL SAGE FOUNDATION

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1919

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THE RUSSELL SAGE FOUNDATION
Printed May, 1912
Reprinted November, 1912
Reprinted July, 1913
Reprinted March, 1917
Reprinted May, 1919

WM · F. FELL CO · PRINTERS
PHILADELPHIA

INTRODUCTION

AS I turn from my laboratory to consider in what words I may fittingly introduce Miss Goldmark's admirable book, two thoughts that have often been with me come to me again. The first is, that among the many conditions of human life which may be classed as causes of misery, there is none more potent than the failure of men to live in accordance with physiological laws. Many men fail so to live because of ignorance; many for the reason that even though knowledge be present, desire is defeated by the fact that within their chosen sphere of labor they are not free agents. If this cause of misery is to be removed, there is needed first of all a knowledge of what is physiological.

Like other men of science, the physiologist is too often content to spend his time in seeking, to which is added the occasional greater pleasure of finding. He tells his discoveries to his colleagues in the language common to both, but too often he does not interpret them to the people; and thus he lets the world at large remain in its ignorance and misery. Even more rarely does he venture to instruct those who shape the conditions under which multitudes of the people live. But he gladly welcomes the services of those individuals who understand physiological laws and their bearing upon human life, and are capable of bringing this knowledge convincingly home to those who are most in need of it.

The second thought that comes back to me is this: Industrialism has been quick to accept the achievements of science in inanimate things, but slow to recognize the teachings of physiology with regard to the man himself. Methods and machines have been revolutionized, but the human element has not yet been eliminated. The man or woman or child is still essential to the method and the machine, and while the inanimate agent demands more and more of him, his fundamental physiological powers are probably not so very different from what they were when he built the pyramids and made papyrus. He may sharpen his attention,

shorten his reaction time, and develop manual skill; scientific management may step in and direct his powers more intelligently; but sooner or later his physiological limit is again reached on the new plane. Try as we will we cannot get away from the fact that so long as machines need men, physiological laws must be reckoned with as a factor in industrialism.

These general principles are well illustrated by a consideration of fatigue. Fatigue is a potent physiological state which enters into all human activities. In its normal manifestation it is a warning. If the warning is not heeded, the condition may become pathological, and that is a sign of something serious. This remarkable mechanism of ours, the human body, is capable of meeting enormous demands upon itself—it is long resistant to abuse. But if work is done, rest is ultimately imperative. Work and rest indeed are as close coördinates as are light and darkness. Without the one the other is destruction. Much remains to be discovered of fatigue and rest, and especially as to their relations in industrialism, but enough is already known to make clear that such knowledge ought to be recognized in and applied to the rational industrial procedure of the future. There is nothing more pathetic than to see an employer disregard the laws of physiology, use his helper to the breaking point, and then cast him aside.

Miss Goldmark has performed a helpful task well. She is fortunate in possessing a knowledge both of physiological laws and of the conditions of industrial labor. Her keen vision, her intelligent sympathy, her capacity for critical analysis, and her apt power of expression are effectively united in this book. She has made a powerful plea for the alleviation on rational, scientific grounds of human misery in one sphere of its manifestation, and she deserves the appreciation and gratitude of all who are interested in the promotion of human efficiency.

FREDERIC S. LEE

Columbia University
April 2, 1912

AUTHOR'S PREFACE

ALMOST five years have elapsed since I first undertook, as Chairman of the Committee on the Legal Defense of Labor Laws of the National Consumers' League, to prepare the first of the briefs contained in Part II of this volume.

I have related in Part I, from the lay point of view, a variety of technical matters, physiological, economic, and legal. In the desire to cite concrete particulars in support of all general or abstract statements, much space has been given to illustrations from contemporary industrial life. And since these matters are for the most part still controversial, effort has been made to give, in the footnotes, the confirming documentary authorities. Wherever it has been necessary to choose between public or private research in describing facts, preference has been shown to the reports of government investigation, since they are usually held to be the more impersonal records.

I have endeavored throughout to steer a middle course between the technical and the popular, aiming to pursue the technical arguments only so far as they are essential for serious discussion, without involving the reader in technical intricacies needed only by the specialist.

This was the principle followed also in preparing the material for Part II which was originally contained in various briefs. The initial suggestion so to present the world's experience regarding women's hours of labor, in defense of the first woman's labor law before the United States Supreme Court, came from Mr. Louis D. Brandeis. I have described in Chapter IX his connection with these briefs. They were prepared under his personal direction, and have been used by him in the successful defense of various state laws limiting women's hours of labor. A special fund was raised by the

National Consumers' League to meet the heavy expense of printing briefs of such large compass. They are reprinted here to meet a steady demand for documents in a sense historical, from colleges and libraries, as well as from persons engaged in the more practical business of securing labor legislation. The briefs are reprinted substantially intact, as they were submitted to the courts; for while, taken separately, they contain evidence and opinions of unequal worth, yet their main value consists in precisely the cumulative testimony and the unconscious unanimities of experience revealed.

Thanks are due to many persons for their assistance in collecting the widely scattered material contained in the briefs. The Russell Sage Foundation co-operated with the National Consumers' League, supplying the funds for a small staff of readers, who under my direction covered a literature of wide but uncharted range. I am glad to acknowledge here the valuable assistance of Miss L. L. Dock, R. N., whose technical knowledge enabled her to supply most of the translations from French and German authorities quoted in the briefs. Dr. Ira P. Wile of New York kindly read all of the scientific authorities quoted in the briefs, and gave the benefit of his advice in the choice of such material. For access to the scattered files of European reports, and for other courtesies, I am indebted to several libraries, chief among them the Library of Columbia University, the Library of Congress at Washington, and the Library of the United States Bureau of Labor. To Dr. Zacher, of the German Imperial Insurance Office, I am indebted for material not otherwise easily accessible.

In writing the text of Part I—a task which has been necessarily interrupted by the various cases and legislative work arising within the past four years—I have been constantly aided, in untold ways, by Mr. Brandeis' generous and stimulating counsel, without which this book would not have been undertaken, and for which I am more in his debt than these poor words can express.

I am under great obligations to Dr. Frederic S. Lee, Dalton Professor of Physiology at Columbia University, for

taking time, in the midst of his scientific activities, to read all the proof sheets of my text and to give the benefit of his criticisms in the field of which he is a master.

The manuscript was read also by two other persons—my sister, Pauline Goldmark, and Mrs. Florence Kelley. To both I am indebted for valuable criticism. To Mrs. Kelley I owe gratitude also for years of the most generous association in the work of the National Consumers' League, and for the stimulus of that pure spirit of justice towards all mankind of which she is, as it were, a voice and an embodiment.

PREFACE TO THE THIRD EDITION

The first two editions of this book contained, as Part II, reprints of various briefs defending laws which regulate women's hours of labor. In response to a demand for a smaller volume, the text contained in Part I of the earlier edition is here reprinted under the same title as the complete edition.

The present edition contains a new and complete compilation of the American laws regulating women's hours of labor. It gives not only extracts from the statutes of all the states, but also comparative schedules, in tabular form, which show at a glance the standing of each state in regard to the degree of protection afforded.

TABLE OF CONTENTS

PAGE

INTRODUCTION. By Frederic S. Lee, Ph.D. v

AUTHOR'S PREFACE vii

PREFACE TO THE THIRD EDITION ix

I. INTRODUCTORY 3

II. THE NATURE OF FATIGUE 9

1. One Factor in Fatigue: Accumulation of Waste Products . 11

2. The Measurement of Muscular Fatigue 14

(a) In animals 14

(b) In man 18

3. Another Factor in Fatigue: Consumption of Energy-Yielding Substance 20

(a) The Chemistry of Muscular Contraction: How Glycogen is Supplied and Consumed . . . 21

(b) How Oxygen is Supplied for Muscular Contraction . 23

4. The Nature of the Fatigue Products 25

5. The Nature of Nervous Fatigue 27

(a) The Nervous System, Central and Peripheral . . 28

(b) The Location of Nervous Fatigue. 29

6. The Rise and Fall of Working Capacity. 33

(a) Work Continued Under Fatigue Costs More Effort . 33

(b) The Nature of Training 35

7. The Greater Morbidity of Women 39

III. THE NEW STRAIN IN INDUSTRY 43

1. Speed and Complexity 43

(a) The Telephone Service 43

(b) Speed in the Needle Trades 53

(c) The Textile Industry 56

PAGE

2. Monotony 58
   (a) The Canneries 59
   (b) Shoe Making 64
3. Physiology of Monotony 67
4. Noise 68
5. Fatigue and Industrial Accidents 71
6. Rhythm 79
7. Piece-Work 82
8. Overtime 84

IV. Some Specific Studies of Physical Overstrain in Industry 90
1. Infant Mortality 91
2. Low Birth Rate 95
3. Race Degeneration 97
4. Lack of Information in the United States 100
5. Medical Study of Working People in Foreign Insurance Societies 101
6. The Increase of Nervous Disorders 103
7. General Predisposition to Disease 111
8. A New Medical Scrutiny of Overwork 112
9. Opportunities for Such Study in the United States . . . 115

V. Economic Aspect of Regulation: Fatigue and Output. 121
1. General Experience in England 123
2. General Experience in the United States 131
3. An Experimental Study of Output 133
4. The Experience of the Salford Iron Works at Manchester, England 138
5. The Experience of the Engis Chemical Works near Liége, Belgium 144
6. The Experience of the Zeiss Optical Works at Jena, Germany 155
7. The Trend Toward Shorter Hours in the United States . 167

VI. Regularity of Employment: Fatigue and Overtime Work 175
1. Overtime as a Separate Issue 175
2. Overtime and Regularity 177

PAGE

3. Efforts to Equalize Seasons 178
4. The Adaptation of Customers 180
5. The Policy of Persuasion by Consumers. 182
6. The Legal Prohibition of Overtime 184

VII. The New Science of Management: its Relation to Human Energies 192
1. Differences Between Ordinary Speeding-up and the New System 193
2. Benefits of the New System 201
3. Dangers of the New System 203
4. Scientific Management and Collective Bargaining . . . 208

VIII. The Enforcement of Labor Laws 211
1. The Rigid Law: Historical Development in Massachusetts. 212
2. The Rigid Law: Historical Development in Great Britain 216
3. The Elastic Law: Historical Development in Great Britain 218
4. Elastic Laws in the United States 223
5. Two Tests of Efficiency 228
(a) The Annual Report 228
(b) The Observation of Health in Industrial Establishments 233
6. Some Technical Requirements in Factory Inspection . . 236

IX. Labor Laws and the Courts 242
1. The Police Power 242
2. The "Freedom of Contract" Theory 243
The First Ritchie Case 244
The Case of Holden v. Hardy 245
The Lochner Case 246
The Williams Case and its Challenge 247
The Oregon Case and a New Line of Defense. . . . 251
The Second Ritchie Case 253
3. The Distinctions of Sex 253
4. The Question of Discrimination 257

X. Prohibition of Women's Night Work: a Prime Necessity 259
1. The International Convention on Night Work . . . 259
2. The Case Against Night Work Abroad 265
3. Night Work in the United States 269

XI. Conclusion 278

APPENDICES

PAGE

A. Laws Regulating Women's Labor 291
I. Comparative Schedules 291
A. Hours of Labor 291
B. Overtime Allowed 302
C. Exemptions 303
D. Night Work 304
II. Extracts from Statutes 305
B. Opinion of United States Supreme Court in Muller v. State of Oregon 320

INDEX 329

FATIGUE AND EFFICIENCY

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I

INTRODUCTORY

THE aim of this book is to present, as a new basis for labor legislation, the results of the modern study of fatigue. It seeks to show what fatigue is, its nature and effects, and to explain the phenomena of overwork in working people. It draws upon the scientific study of fatigue —one of the most modern inquiries of physiological, chemical, and psychological science—for aid in the practical problem of reducing the long working day in industry.

Such a scientific basis of legislation has been almost wholly absent during the century which has elapsed since the first factory laws were enacted. First for lack of the necessary scientific equipment, and in recent times, for lack of that coördination of knowledge which should apply the teaching of science to the problems of a new industrial order, labor legislation has been deprived of the authoritative sanction which it might have. In this country, at least, the laws of fatigue, verified by years of experiment in the seclusion of the laboratory, have been practically unknown to those who have been most active in preserving for working people a minimum of human leisure.

Yet such scientific authority is precisely what is most needed today for a more rational progress in the future than in the past; something more exact and demonstrable than the appeal to pity, less subject to temporary variations than what the Italian physiologist Treves calls the "illusory profits of long hours." Just because the more cruel, dramatic exploitation of workers is in the main a thing of the past, exact scientific proof is needed of the more subtle injuries of modern industry, its practically illimitable speed and strain. After a hundred years of human experience

throughout the world, it remains true in our own country that the most helpless workers are still, in respect to the length of their working hours, the least protected.

The most recent government investigation of the iron and steel industry in the United States shows* that of the 172,671 employes whose hours of labor were reported in May, 1910, nearly one-half (42.58 per cent) were kept at work seventy-two hours a week or over; that is, at least twelve hours daily on six days of the week. Nearly a quarter of all the workers (20.59 per cent) were kept employed eighty-four or more hours in the week; that is, at least twelve hours each day, including Sundays. In the largest single department in the industry, the blast furnaces, 88 per cent of the 31,321 employes, engaged in both productive and general occupations, were regularly kept at work seven days in the week.

These prodigious and terrible figures concern the work of men. It might reasonably be supposed that the century-long effort to gain legal protection for women and children in industry would have safeguarded them from the bare possibility of such inhuman usage.

But, to mention only random examples, young boys of fourteen years may still be employed all night long in Pennsylvania, West Virginia, and other great glass producing states; girls upon reaching their sixteenth birthday in New York state may be employed twelve hours a day during five days of the week in factories,† and unlimited hours in stores during the season of "rush" before Christmas. The decision of the Illinois Supreme Court in 1910, upholding the constitutionality of the ten-hour law for women employed in factories and laundries, is estimated to have freed from overstrain in Illinois alone more than 30,000 working women who were employed over ten hours a day. Some great manu-

* Report on Conditions of Employment in the Iron and Steel Industry in the United States. Summary of the Wages and Hours of Labor, pp. 36 and 57. Senate Document No. 301, 62nd Congress, 2nd Session, 1912.

† The New York factory law was amended in 1912 so as to prohibit the employment of women more than ten hours in one day or fifty-four hours in one week.

facturing states, such as Alabama and Mississippi in the south, and New Jersey in the north,* set no legal limitation whatsoever upon the hours of women's employment. This is true also of other states, such as Delaware, Kansas, and Iowa, where manufacture is not yet foremost but where thousands of women are working overlong hours in laundries, restaurants, and department stores. Indeed, only 15 states† have enacted laws to check the overwork of women in the exhausting service of the modern department store; and conspicuous by their absence from among these, are states with large commercial centers, such as Maryland,* New York, Ohio, and Rhode Island.

Like most human institutions, factory legislation has been founded on no *a priori* logic. It has been, rather, essentially illogical, the result of half-way measures and opposing forces. During the nineteenth century, while agricultural Europe and America were gradually becoming industrial and the whole face of nature reflected the new order, the history of factory legislation—the state's defense of its workers—has been devious advance and compromise. Self-interest on the one side, self-defense and philanthropy on the other, hampered by prejudices of every sort,—these for the most part have brought about such protection as exists today. Not man's foresight, but the inexorable results of labor long carried on counter to nature's laws, have been on the whole responsible for the meager protection which industrial communities have granted their workers.

In the main, opposition to laws protecting working women and children has come from the unenlightened employer, who has been blind to his own larger interests and who has always seen in every attempt to protect the workers an interference with business and dividends. To this day, it is the shortsighted

*New Jersey, Maryland and Kentucky have enacted ten-hour laws for women as this book goes to press (April, 1912).

† California, Connecticut, Illinois, Louisiana, Massachusetts, Michigan, Minnesota, Missouri, Nebraska, Oregon, Pennsylvania, South Carolina, Utah, Washington, and Wisconsin. The New York law applies only to girls up to 21 years.

and narrow-minded spirit of money-making that is the most persistent enemy of measures designed to save the workers from exhaustion and to conserve their working capacities. Work itself is of the essence of life; without it, man's physical as well as his moral nature decays. Regular continuous labor and exertion is as necessary for the worker's health as it is for subsistence, and if legislation regulating the workday had sought to invade legitimate work, it would long ago have defeated its own end. What it does seek is to check and control overwork, to conserve the workers from labor which leaves them spent and worn at thirty-five and forty years, when they should be in their prime.

In most European countries, and in some of our states, legislation has usually been preceded by parliamentary commissions and investigations. The testimony of physicians who have practiced among factory populations, and factory inspectors who have been in daily contact with the workers, furnishes an impressive array of opinions and evidence on the practical effects of the long working day.

Thus, for example, when in the first days of factory legislation, almost a century ago, Sadler's Committee sat and learned what the working children of England were suffering, the most impressive testimony was that of the physicians. Many medical men in turn testified to the hideous overwork menacing the health of England. By 1844 Lord Shaftesbury could maintain in Parliament that, since 1816, 80 surgeons and physicians and three medical commissioners speaking for the medical men of Lancashire, had asserted "the prodigious evil of the system." * Buried in musty volumes on remote library shelves, describing cruelties to children now happily long past, these terrible pages of testimony strike at the outset the keynote of factory legislation: the benefit to health and output, to physical and economic life.

Just seventy-five years later, in another continent, another memorable group of physicians presented what is, perhaps, the most impressive medical testimony of the last

* Hansard's Parliamentary Debates, 3rd Series, March 15, 1844.

quarter century on the subject of overwork. This was in the controversy between the Bell Telephone Company of Toronto, Canada, and their girl employes, concerning a species of industrial strain unknown to the early nineteenth century, typical of almost incredible changes wrought in less than three generations. Twenty-six prominent Toronto physicians and neurologists described the injuries accruing to young women in the exhausting telephone service, and laid down what seemed to them minimum requirements for health and efficiency.*

The testimony of physicians, of which these are the earliest and latest examples, and the long files of factory inspectors' reports, repeat in country after country, in historical sequence, similar experiences: the same enthusiasm for industrial expansion with indiscriminate employment of old and young; the same exploitation, the same suffering, and the same need of protection. Conditions and industrial processes differ, different trades are described, different people discussed, but, unknown to one another, and terrible in their unconscious unanimity, these observers ring the changes upon the common human facts at issue—exhaustion and deterioration following in the wake of the long working day and working night. Workers of many nations pass before one as one reads; men, women, and young children drawn into the industrial whirlpool, as the wave of invention and development strikes their respective countries,—and protection follows slowly after.

Thus, England stood first in industry at the close of the eighteenth century. By the time one generation had grown up under the new régime, the evils of exploitation called irresistibly for some check, and the first general act in protection of working children—feeble precursor of a long sequence —was passed in 1833. France, the next to enter the industrial race, began to legislate for the workers in the late

* Report of the Royal Commission on a Dispute Respecting Hours of Employment, between the Bell Telephone Company of Canada, Ltd., and Operators at Toronto, Ontario. Ottawa, 1907.

forties, Switzerland following in the seventies, Austria, Holland, and Germany in the next two decades, Italy at the close of the century. Similarly in our own country, Massachusetts and the other New England states where the first cotton mills were operated, were the first to find that legislative protection must shield the workers to conserve them.

First the new industry, then exploitation, then the demand for some measure of protection—such is the universal story. Nor is this a chance sequence. It is the relentless record of history, the more impressive for its unconscious testimony to a waste of human effort and experience, in retrospect scarcely credible among a thinking people, yet in our very midst persisting steadily to this day.

II

THE NATURE OF FATIGUE

STRIKING as is the unanimity of the world's industrial experience and the testimony of observers in each country as to the need of more complete protection for the workers, such empirical data furnish, after all, no scientific basis for labor legislation. They are arguments, legitimate presumptions in its favor, not scientific proof.

Yet a scientific ground for such legislation does exist and is available today. The fundamental basis for laws regulating the working hours of men, women, or children in industrial occupations—at the spindle or loom, in machine shops or laundries, behind the counter or in the glass-houses —is the common physiological phenomenon, fatigue, the normal result of all human action. For fatigue is nature's warning signal that the limit of activity is approaching. Exhaustion, or overfatigue, follows when the warning is disregarded and the organism is pushed beyond its limits by further forced exertions.

In this inexorable sequence, subject to countless variations but never failing, we have a broad fundamental basis for the short working day in industry: a physiological necessity inherent in man's structure for allowing an adequate margin of rest. The regulation of working hours is the necessary mechanism to prevent overfatigue or exhaustion, forerunner of countless miseries to individuals and whole nations.

It is precisely in explaining the normal and abnormal aspects of fatigue, its nature, effects, and relation to all human life, that science can give its authoritative sanction to labor legislation. For, during the last century, unknown to those who saw the practical results of overwork in industry and

sought a legal remedy year after year, so often in vain, men of various sciences were studying the same phenomena in the laboratory. The physiologist, chemist, bacteriologist, and psychologist have contributed to the study. The scientific investigations of fatigue in its varied aspects make up a wide and growing literature. In spite of still unverified details, the underlying principles and laws have been agreed upon.

The study of fatigue, as applied to industry, is not an academic nor a remote speculation. It shows why the system of long hours must, physiologically, result in human deterioration and inferior output. It should help, also, to determine what protection is needed in the future for workers under modern conditions of labor, viewing the new conditions and their demand on human energies from the physiological standpoint.

Such a change of front, indeed, from the purely economic to the broadly physiological, is what this study chiefly advocates. Heretofore, the scientifically wellknown principles of fatigue have not been utilized in the protection of the workers, just because they have been unknown to those persons who could have benefited most directly: the legislators who frame the laws, the enlightened employers who need legislation to restrain unscrupulous competitors, the trade unions and philanthropic agencies which have promoted legislation, and the judges whose official sanction of the laws must precede enforcement. To all these, in the main, the contributions of science on the subject have been unknown. To the scientist, on the other hand, the industrial world has been an undiscovered country. Even physicians and students of hygiene are to a large extent unacquainted with the vast speed and complexity of processes to which industrial workers are subjected. They hardly know, for instance, how machinery is additionally speeded each year; how, to cite a single example from the needle trades, the newest power sewing machines run by girl operators carry 12 needles instead of one, or set almost 4000 stitches a minute, each thread and needle to be intently watched for breaking as

the material is guided on its rapid passage. Changes of which this is typical have added to the strain of industry in a progressive ratio, and, obviously, add also to all the elements which make up the worker's fatigue.

1. ONE FACTOR IN FATIGUE: ACCUMULATION OF WASTE PRODUCTS

A brief account of the scientific views of fatigue must be given, before considering their practical application to the problem of overstrain in industry. We must familiarize ourselves with enough of the technical vocabulary and history to understand the scientific conception of fatigue in general, and that of industrial workers in particular.

Physiology teaches that life is a continual change of structure. The structural basis of all tissue, muscular, nervous, connective, etc., is the cell. The life of the tissue consists in chemical combination of the protoplasm or substance of the tissue cells with the nutritive materials derived from food stuffs and the oxygen of the air. The distinctive property of the cell—that indeed which makes it living—is its power of taking to itself and converting to its own substance materials that are not living. This is a double process; for, just as the potential stuff is seized and wrought into live tissue, so the outworn, dead matter which is no longer of use is cast off and ultimately expelled from the body.

This never-ending, never-ceasing business of life was depicted by Sir Michael Foster, the foremost British physiologist, with all the delicacy of fancy.*

"Did we possess some optic aid," he writes, "which should overcome the grossness of our vision, so that we might watch the dance of atoms in this double process of making and unmaking in the living body, we should see the commonplace lifeless things which are brought by the blood, and which we call the food, caught up into and made part of

* Foster, Sir Michael: Weariness. (Being the Rede Lecture delivered before the members of the University of Cambridge, June 14, 1893.) *The Nineteenth Century*, Vol. 34, No. 199, p. 339. (Sept., 1893.)

the molecular whorls of the living muscle, linked together for a while in the intricate figures of the dance of life, giving and taking energy as they dance; and then we should see how, loosing hands, they slipped back into the blood as dead, inert, used-up matter. In every tiny block of muscle there is a part which is really alive, there are parts which are becoming alive, there are parts which have been alive but are now dying or dead; there is an upward rush from the lifeless to the living, a downward rush from the living to the dead. This is always going on, whether the muscle be quiet and at rest, or whether it be active and moving. Some of the capital of living material is always being spent, changed into dead waste, some of the new food is always being raised into living capital."

Two processes of cellular life are thus continually carried on in the living body: assimilation, or building up, known as anabolism; disassimilation, or breaking down material into simpler chemical forms (ultimately expelled as waste products), known as catabolism. Upon these two processes together, or metabolism, life itself depends, and to this fundamental basis of life we must turn for an explanation of what fatigue is.

The blood is the medium through which nutritive materials are carried to the tissues, and through which also the chemical products of tissue destruction are carried off. These chemical wastes are poisonous impurities, created by the vital activities of the organism, and it is precisely to their accumulation in the blood that fatigue is largely due.

In Sir Michael Foster's words:*

"As the breath of man is poison to his fellow men, so the outcome of the life of each part of the body, each tissue, be it muscle, brain, or what not, is a poison to that part and its fellows, and may be a poison to yet other parts. Of each member, while it may be said that the blood is the life thereof, it may with equal truth be said, the blood is the death thereof; the blood is the channel for food, but it is also a pathway for poison."

* Op. cit., p. 350.

During activity, as will be shown later, the products of chemical change increase. A tired person is literally and actually a poisoned person—poisoned by his own waste products. But so marvelously is the body constructed that, like a running stream, it purifies itself, and during repose these toxic impurities are normally burned up by the oxygen brought by the blood, excreted by the kidneys, destroyed in the liver, or eliminated from the body through the lungs. So rest repairs fatigue.

This balance is kept true and fatigue is repaired just as long as it remains within physiological limits; that is, as long as activity is balanced by repose, when the noxious products of activity are more quickly eliminated and tissue is rebuilt. Just as soon as the metabolic equilibrium is destroyed the organism becomes clogged by its own poisons, exhaustion results, and health is impaired. The physiological normal phenomenon of fatigue becomes pathological, or abnormal exhaustion.

Health, even life itself, hangs upon the metabolic balance. In extreme instances of overexertion, as when hunted animals drop dead in the chase, they die, not from overstrain of any particular organ, such as the heart, but from sheer chemical poisoning due to the unexpelled toxins of fatigue.

"The poisons are more and more heaped up, poisoning the muscles, poisoning the brain, poisoning the heart, poisoning at last the blood itself, starting in the intricate machinery of the body new poisons in addition to themselves. The hunted hare, run to death, dies not because he is choked for want of breath, not because his heart stands still, its store of energy having given out, but because a poisoned blood poisons his brain, poisons his whole body."*

In animals which have so died of exhaustion, the blood is found loaded with the products of chemical action. Abnormally rapid putrefaction and rigidity of the muscles follows after death. In man, the occurrence of actual death

* Foster, op. cit., p. 351.

from overexertion is rare. A historic instance often quoted is the case of Eukles, the immortal runner from Marathon, who fell dead as he announced to Athens victory over the Persians. An Italian pathologist, Professor Pieraccini of Florence, quotes two interesting modern examples in Algeria.* Two native runners fell dead on arrival, one after covering 192 kilometers in 45 hours, the other 252 kilometers in 62 hours. Abnormally rapid rigidity and putrefaction of the bodies followed, and after an autopsy death was ascribed to the "excess of fatigue."

Such then are the extremest results of the self-generated poisons of fatigue. Physiological processes turn pathological; the normal instruments of life become agents of death. Obviously, on this side of death, there is a wide range of injuries which metabolic products can inflict upon the human frame. But before addressing ourselves to such specific ills we must examine more closely the proofs that fatigue results from the chemical wastes of activity. We must acquaint ourselves with the complex processes by which fatigue exhausts and rest repairs the muscular and nervous functions. And since this study of fatigue which we are to review, has scarcely yet concerned itself with the appearance of fatigue in industrial workers, we must turn our attention temporarily from labor and industry to the apparatus of the laboratory and to animal experimentation.

2. THE MEASUREMENT OF MUSCULAR FATIGUE

(a) In Animals

More than forty-five years ago, in 1865, the German physiologist Ranke first investigated the depressant action of certain products of protoplasmic activity upon muscular contraction.† He demonstrated that if an extract of fatigued frog muscle was injected into a second frog, the muscles of

* Pieraccini, G.: Patologia del Lavoro, p. 18. Milan, 1906.

† Ranke, J.: Tetanus. Englemann, Leipzig, 1865; Centralblatt für die medicinischen Wissenschaften, 1868, Vol. IV, p. 769.

the second animal showed evidences of fatigue. Their power of contraction on stimulation was diminished. A similar experiment with an extract made from resting muscle had no such effect.

About twenty-five years later, the Italian scientist Mosso showed that the depressant action of fatigue substances is not confined to the tissues in which they arise.* He demonstrated that the blood becomes charged with these chemical wastes produced in the muscles, and carries them to all parts of the body. He proved this by injecting the blood of a dog fatigued by long continued running into the vessels of a second dog from which an equivalent amount of blood had been drawn. Upon this, the second dog showed the usual signs of fatigue.

Products of muscular activity are thus shown to cause symptoms of fatigue when injected into resting tissue. In the study of muscular fatigue we may learn how these waste products are created and how they affect the organism. Muscular fatigue has been longest studied since fatigue of the muscles can be most easily observed and registered by certain instruments of precision or measurement. The observation of fatigue or diminished power of reaction in frog muscles preceded Mosso's famous studies of human fatigue.

The myograph, designed by H. von Helmholtz, shows how the loss of energy in wearied frog muscles results from noxious substances in the muscles, produced during work. The leg muscle of a frog is separated from the rest of the body and hung by one end upon a support. To the other end of the muscle a lever is attached which comes in contact with a revolving cylinder covered with sooty paper. If the leg is at rest, a straight line is traced upon the revolving cylinder. If the muscle is electrically stimulated to contract, the lever records the contractions by upward and downward marks upon the sooty surface of the revolving cylinder, the height of the curves being determined by the force of the contrac-

* Mosso, Angelo: Arch. für Anatomie u. Physiologie. Physiologische Abtheilung, 1890, p. 89.

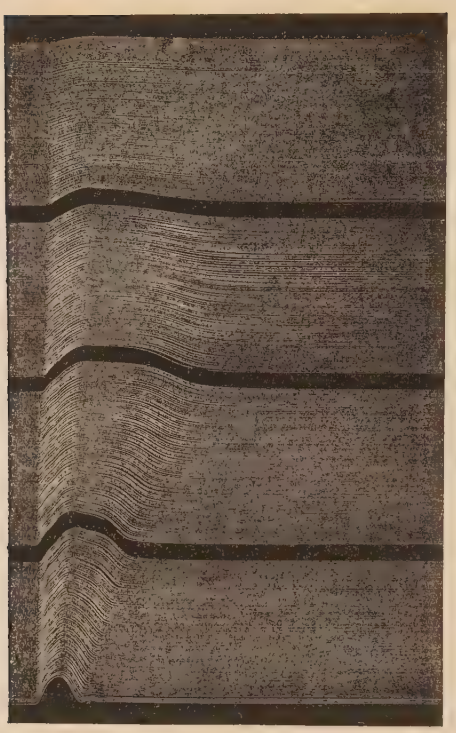

Fig. 1

Series of 550 contractions of a frog's gastrocnemius muscle, excised and stimulated at intervals of two seconds. Every contraction is recorded, except at the places indicated by the black bands, at each of which the records of fourteen contractions are omitted. The record of the first contraction is at the bottom of the figure: that of the last one at the top. Fatigue is shown in the progressive decrease in height and the increase in length of the curves.

tion. As the muscle tires, the contractions grow smaller and smaller until finally the lever cannot be raised at all.*

It can be shown that this fatigue of the muscles is due to the paralyzing action of the accumulated fatigue products

* See Figures 1, 2, and 3. The illustrations are from The Nature of Fatigue, by Professor Frederic S. Lee. *Popular Science Monthly*, Feb., 1910. (Reproduced by permission.)

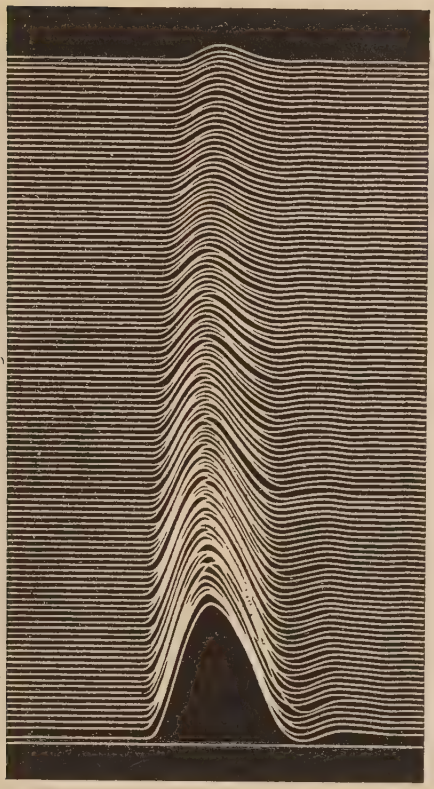

Fig. 2

Series of contractions of a rat's gastrocnemius muscle, excised and stimulated at intervals of two and one-half seconds. Fatigue is shown in the progressive decrease in height of the curves.

in the blood. For if at any time after fatigue has set in, the muscle, while suspended, is washed out through its blood-vessels with a normal salt solution, its power to contract returns. As soon as the fatigue products are washed away, the muscle is rested.*

*See Figure 4.

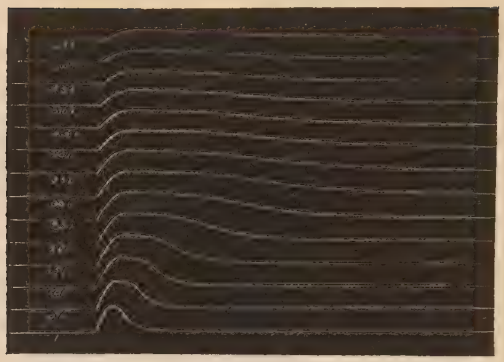

Fig. 3

Series of contractions of the frog's gastrocnemius muscle, excised and stimulated at intervals of two seconds. Every fiftieth contraction is recorded. Fatigue is shown in the progressive lengthening of the descending limb of the curves.

Fig. 4

Series of contractions of a frog's gastrocnemius muscle *in situ* and stimulated at intervals of two seconds. The flow of blood through the muscle was stopped by ligating the artery, and the record of fatigue was made. At the break in the series, the muscle rested five minutes, during which time the ligature was removed and the blood was allowed to circulate through the muscle. The record of contractions at the right of the break was made immediately after the resting period, and while the blood was still circulating.

(b) In Man

Using the same principle described above, Mosso devised an apparatus called the ergograph, to study muscular contraction in man.

"By its means," writes Professor Frederic S. Lee, himself one of the foremost American investigators in this field, "(Mosso) began the long series of studies of voluntary contractions in man, which has made the Turin School famous and has immeasurably extended our knowledge of fatigue in living human beings."*

The ergograph is an instrument constructed so as to record the contractions of a single muscle or group of muscles. Thus, for instance, the arm and hand, except the middle finger, may be supported and held fast. The person experimented upon contracts his middle finger at regular intervals, thereby lifting a known weight to a definite height or stretching a spring of known tension. As in the myograph, contractions are recorded by curves upon a revolving cylinder, and show a steady diminution of the lifting power of the muscles, the rate and regularity of the diminution differing with individuals. If the highest points of the curves recorded on the cylinder are joined together, the result is a curve of characteristic form for each individual, known as the curve of fatigue. This curve remains practically the same for each person whether his contractions are voluntary or due to electric stimulation. Some persons obviously tire less quickly than others; some work at high pressure for a short time, giving out suddenly, while others work more slowly and regularly. All this is borne out by the record of the ergograph, which shows graphically on paper how great are the varieties of individual working capacities. (See Figure 5.)

In industrial occupations, obviously, the working time cannot be measured off for each individual according to his special capacity. But the testimony of the ergograph to the infinite varieties of endowment in strength and staying capacity emphasizes the need of setting a fair maximum working period which shall not over-reach the natural limits of the majority of individual workers.

By the use of the ergograph we learn more of the funda-

* Lee, Frederic S., Ph. D. (Professor of Physiology, Columbia University, New York): Fatigue. Harvey Lectures, 1905–06, p. 172. Philadelphia and London, Lippincott, 1906.

mental factors in fatigue. It is shown that if sufficient rests are allowed between contractions, no fatigue results. With a load of six kilograms, for instance, the flexor muscle of the finger showed no fatigue when a rest of ten seconds was given between contractions. But after complete fatigue, once the

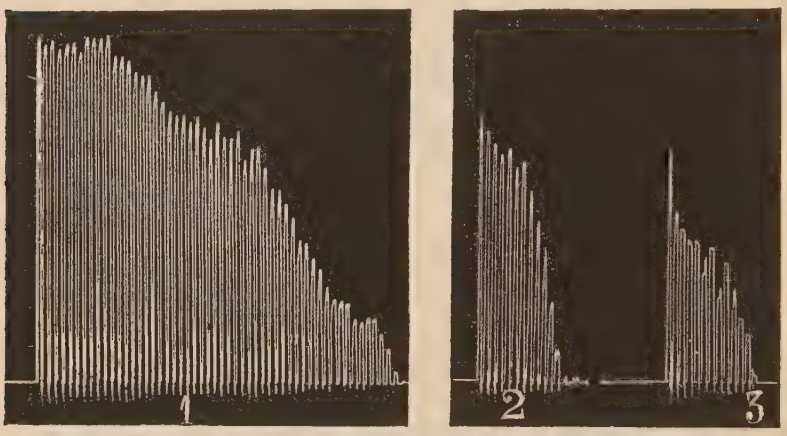

Fig. 5

Series of contractions of the flexor muscles of a human finger. The muscle was stimulated electrically every two seconds, and the resulting contractions were therefore involuntary. Record 1 was made when the muscle was fresh; record 2 immediately after three and one-half hours had been spent in the oral examination of students; record 3 two hours after the completion of the examination. (From Mosso's "Fatigue.")

muscles are exhausted, the utmost expenditure of will power does not enable them to contract further. A very long interval—two hours—is needed for the muscle to make a complete recovery.

3. ANOTHER FACTOR IN FATIGUE: CONSUMPTION OF ENERGY-YIELDING SUBSTANCE

So long an interval of rest would evidently not be necessary for the removal of the poisonous metabolic products, if fatigue were due to the depressant action of these

products alone. The ergographic record, therefore, throws light upon another fundamental factor in fatigue besides the accumulation of fatigue products: the actual consumption of the material from which energy for contraction is obtained. At the termination of hard muscular work the muscle contains a lessened supply of energy-yielding material, because during contraction the processes of disassimilation or catabolism are in excess of those of assimilation or anabolism. This fundamental change in the muscle substance can be made plainer by a brief consideration of the chemical processes in contraction.

(a) The Chemistry of Muscular Contraction: How Glycogen is Supplied and Consumed

Every voluntary muscular contraction is due to the stimulus received from the central nervous system through the nerves. Of the nature of this stimulus little is known, and the nerve elements in activity and fatigue will be considered later. We know that each muscular act has as its basis chemical processes. It is a form of combustion, as we readily recognize by the greater heat generated within us by any muscular effort. For combustion there must be union of some substance with oxygen. The union may be slow, as when iron rusts or is slowly oxidized, or fast, as when wood or coal burns with a flame. In muscular combustion the oxygen is supplied by the blood, the substance with which it combines being the so-called animal starch of the muscles, called glycogen.

Let us, then, first consider how the organism is supplied with these two essential factors for muscular action, glycogen and oxygen.

Glycogen is one of the stored materials of the muscle, a compound of carbon, hydrogen, and oxygen; and muscular tissue has the power of forming this glycogen from the sugar or dextrose brought to it by the blood. Dextrose is the form of sugar in which our carbohydrate foods (starches, sugars, etc., the bulk of our usual diet) are eventually absorbed into

the blood and carried by the blood to the muscular tissues, there to be transformed into glycogen. The stored glycogen of the muscles keeps uniting chemically with the oxygen of the blood. The glycogen is broken down into a simpler chemical form, giving off the gas carbon dioxide and other acid wastes, and releasing heat and mechanical energy in the process.

With the released energy, contraction of the muscle takes place and hence ultimately the industrial labor which is our special theme. The heat contributes to our body temperature. The chemical wastes, as we have seen, poison the whole organism unless prevented from accumulating unduly, and go to constitute what we know as fatigue.

But, as we saw above in considering the ergograph, there is another fundamental factor in fatigue which must be taken into account here: a consumption of energy-yielding material of the muscle itself. This takes place in the following manner:

Glycogen is, as it were, stored for use. It is always being replenished, always being depleted. The metabolic wastes, produced when glycogen is broken down into simpler chemical form, are constantly thrown off; the potential stuff brought by the blood is constantly being seized and built up again into living tissue. But when the muscle is active and contracts energetically, there is a run upon our glycogen. It is used up faster than it is built in muscle. The glycogen is spent so rapidly that there is not time for the bloodstream to bring back to the tissue the potential material for its repair. Glycogen may even be entirely consumed and disappear from the muscle.

But there is another organ of the body which acts further as a storehouse for glycogen. This is the liver, whose cells are so constructed that they too convert the dextrose or sugar in the blood into glycogen and retain it, until the store in the muscles is so far depleted that it must be replenished. If it were not for the stored glycogen of the liver which is supplied to the muscles at their need, starvation would more quickly end in death.

Even this provision of stored glycogen, however, does not suffice after prolonged and severe work to supply oxidizable material for muscular activity. After excessive labor the entire store of glycogen in the liver as well as in the muscle may be practically used up. Thus we have reached the other fundamental factor in fatigue,—the consumption of the energy-yielding substance itself. Not only does tissue manufacture poison for itself in its very act of living, casting off chemical wastes into the circling bloodstream; not only are these wastes poured into the blood faster with increased exertion, clogging the muscle more and more with its own noxious products; but finally, there is a depletion of the very material from which energy is obtained. The catabolic process is in excess of the anabolic. In exhaustion, the organism is forced literally to "use itself up."

We shall see later how destructive to health this phenomenon of exhaustion is, to which nervous as well as muscular tissue is subject; how long it takes to make good such losses; how exhaustion, indeed, taps the very source of our energies.

(b) How Oxygen is Supplied for Muscular Contraction

Hitherto in this discussion we have referred constantly to the chemical reaction between glycogen and oxygen, and the results obtained when glycogen is thus broken down by oxygen. It remains now to trace how at every breath we draw, oxygen is supplied for our internal combustion of glycogen; how at every exhalation we breathe out the gas carbon dioxide—product of muscular action. The pathway for these gases is the blood.

When oxygen is breathed into the air sacs of the lungs, it comes into contact with the smallest blood vessels of the body, the capillaries. The blood in these thin-walled capillaries is separated from the oxygen in the air sacs only by moist and permeable membranes. By diffusion, the oxygen passes through these moist membranes and combines chemically with the hæmoglobin or red coloring matter of the red corpuscles in the capillaries. These tiny blood vessels, now

oxygen bearers, penetrate in a fine network to every tissue and organ in the body. As soon as the blood reaches the muscles, the loose chemical union of the haemoglobin and oxygen is again broken down, the oxygen combining with the glycogen of the muscle tissue, setting free energy, as we have seen, and evolving waste products. For, as the oxygen streams out to combine with the glycogen, there streams back in the opposite direction the gas carbon dioxide, thrown off in the chemical process.

"There is an upward rush from the lifeless to the living; a downward rush from the living to the dead."

The lifeless carbon dioxide in its turn combines with the blood, which has given its oxygen to the tissue; and in the intricate flow of our vascular system, carbon dioxide is carried back by the blood to the lungs and thence expired. We may get some notion of the combustion or chemical process carried on within our muscles by the fact that at every breath air loses about 5 per cent of its oxygen and increases in carbon dioxide a hundred fold.*

	O	N	CO_2	
Inspired air contains.....	20.96	79.00	0.04	
Expired air contains.....	16.40	79.19	4.41	
Loss.....	4.56	.19	4.37	Gain

Moreover, it has been proved that after heavy muscular work, an animal gives off even larger proportions of carbon dioxide in its expired air. The physiologists Voit and Pettenkofer showed as early as 1866, that during a day in which much muscular work was done, a man expired almost twice as much carbon dioxide as during a resting day. During activity the internal combustion is more active, glycogen is being broken down more rapidly, more wastes are being thrown into the blood, more carbon dioxide is evolved. The wastes indeed accumulate more rapidly than they can be carried off, and hence, as we have seen, after excessive exer-

* Notter, J. Lane, and Firth, R. H.: The Theory and Practice of Hygiene, p. 151. Third Edition. London, J. V. A. Churchill, 1908.

tion, the metabolic equilibrium is destroyed. But during rest at night the processes of repair are again in the ascendant. If sufficient rest is not allowed between working days, obviously a physiological deficit must result.

This is the essential injury of consecutive days, weeks, and months of overtime work, which we shall find common to many branches of industry,—that the normal season of tissue repair, between working days, is cut down at the very time when the severest demands are being made upon the human organism.

4. THE NATURE OF THE FATIGUE PRODUCTS

The production of carbon dioxide has been called the most significant change in the muscle during contraction. The nature of other toxic products of muscular action is shown by laboratory examination. Fatigued muscle is shown by litmus paper to be acid in reaction. A wellknown experiment illustrates the acidity of fatigued muscle by the use of acid fuchsin. This stain is injected under the skin of a frog. It is absorbed and distributed in the body without injuring the tissues. As long as the body remains at rest, the solution is colorless; but if one of the legs is electrically stimulated the muscles take on a red color, showing that an acid is produced locally.

"It is now customary," writes Professor Lee, "to recognize three distinct metabolic products as fatiguing, namely—sarcolactic acid, monopotassium phosphate and carbon dioxide, all of which are acid in reaction."*

Within the last few years the German scientist, W. Weichardt, has published special studies of chemical fatigue

*Op. cit., Harvey Lectures, 1905–06, p. 183. See also by the same author: Cause of the Treppe. *Amer. Jour. of Physiology*, Vol. XVIII, No. III, p. 267 (April 1, 1907). The Action of Normal Fatigue Substances on Muscle. Ibid., Vol. XX, No. I, p. 170 (Oct. 1, 1907). Pseudo-Fatigue of the Spinal Cord. Ibid., Vol. XXIV, No. IV, p. 384 (July 1, 1909). Physical Exercise from the Standpoint of Physiology. *Science*, N. S., Vol. XXIX, No. 744, p. 521 (Apr. 2, 1909). The Nature of Fatigue. *Popular Science Monthly*, Feb., 1910, p. 182.

substances. In 1904 Weichardt claimed to have isolated from fatigued muscles a specific toxin of fatigue, entirely analogous to other bacterial toxins, such as that of diphtheria or tetanus.* He asserts that if this toxin obtained from the extract of fatigued muscles is injected into animals, it produces all the symptoms of fatigue. When given in large doses it is said even to cause death. In human beings the production of fatigue toxin is supposed to take place with ordinary physiological fatigue.

Weichardt even lays claim to having obtained a true anti-toxin of fatigue. He asserts that when small doses of the toxin are administered to animals, a specific anti-toxin is produced in the blood, under the influence of which the muscles of the animals experimented upon display far less fatigue than under ordinary conditions. Their endurance capacity is said to be largely increased by injection of the anti-toxin. When corresponding amounts of the anti-toxin were given with doses of toxin, the paralyzing effects of the latter were said to be counteracted.

These later theories and experiments, verging on the fantastic, have not been cordially accepted by the scientific world. In the eight years which have elapsed since Weichardt's discovery was announced, it has been confirmed by no other eminent investigator. At present, his theories of fatigue toxin and anti-toxin must still be regarded as uncorroborated.

Moreover, even if further scientific investigation should sustain Weichardt's assertions, they would be of theoretic not practical interest and value. The injection of an anti-toxin of fatigue might possibly be resorted to in athletic endurance tests and *tours de force,* such as six-day bicycle races. Ob-

* Weichardt, W.: Über Ermüdungstoxine und deren Antitoxine. Münchener medizinische Wochenschrift, 1904, 51. Jahrgang, No. 1, pp. 12–13.
Ibid., 1904. No. 48, pp. 2121–2126.
Ibid., 1905. No. 26, pp. 1234–1236.
Ibid., 1906. No. 1, pp. 7–10.
Ibid., 1906. No. 35, pp. 1701–1702.
Vierteljahresschrift für öffentliche Gesundheitspflege. XXIX. 1907. Ermüdungs- u. Übermüdungsmassmethoden.

viously no such artificial stimulus could be of any concern in the daily regimen of industry with which we are concerned.

A glimpse at theories of fatigue toxin and anti-toxin is of interest to us chiefly as additional evidence of the gravity and the scientific nature of our problem. Overstrain in industry is obviously no invention of sentiment or fiction when the chemical nature of fatigue and its complex relations with life are realized. The more we learn of the scientific nature of fatigue, the more it invites us to utilize such knowledge for the improvement of working conditions.

5. THE NATURE OF NERVOUS FATIGUE

Thus far we have confined ourselves to a consideration of the main underlying causes of fatigue in the breakdown of normal metabolism, and we have glanced at the manifestations of muscular fatigue. We must proceed now to other forms of fatigue, nervous and psychic.

Such is the oneness of life, the controlling unity of the living body, that we cannot practically estimate any one form of fatigue separately; we cannot set definite limits where nervous fatigue ends and muscular fatigue begins, or vice versâ. They are inevitably bound up together, since every voluntary muscular act is due to the stimulus received through the nerves from the central nervous system. Of the nature of the nerve impulse or of the energy generated in the centers, little is agreed upon, excepting that some form of electric activity is involved.

But though the origin of nerve impulses be still unknown, shrouded in the mystery of life itself, it is undoubted that our levels of nervous endurance and resistance may be permanently lowered by excessive pressure upon them. Further, we know that nervous energy is not only the stimulus of muscular action, but the controller of all our functions; the "very pulse of the machine." Hence nervous fatigue and exhaustion is the most destructive because the most inclusive form of fatigue.

We have seen that toxic products are thrown off by the muscles and are carried in the blood. When fatigued blood becomes laden with these substances they affect other muscles through which the blood circulates. Thus, after an exhausting walk, as Mosso explains, the muscles of the arms as well as of the legs are indisposed to further great exertion. Maggiora, a student and follower of Mosso, demonstrated this fact with the ergograph. He says:

"After a fatiguing day's march, certain soldiers' hand tracings showed a notable diminution of energy even after the night's rest, being very low at 7 a.m., less so at 9 and 11 o'clock, but rising to normal energy only by 3 p. m."*

Now, just as the metabolic poisons created in one set of muscles are carried by the blood, and act upon other muscles, so they act also upon our nervous system—upon nerve endings in muscle and upon central nerve cells. Further, it is agreed that there is a metabolism of the nervous tissue itself similar to that of muscle tissue, a similar building up and breaking down of energy-yielding material. Hence fatigue of the nervous system is ascribed to the same double origin as muscle fatigue: accumulation of toxic waste products, and consumption of substances essential for activity.†

(a) The Nervous System, Central and Peripheral

The nervous system is composed of the central nervous system,—the brain and spinal cord; and the peripheral system, —nerve ganglia and nerve fibers arising from the centers. When a number of nerve fibers are bound together in a bundle or trunk, we have the plainly visible whitish nerves. These are distributed to all parts of the body. Every organ and tissue has its own supply of nerves connecting it with the brain or spinal cord.

* Archiv für Anatomie u. Physiologie, 1890, p. 191. Physiologische Abtheilung. Maggiora, Dr. Arnaldo: Über die Gesetze der Ermüdung.

† Howell, Wm. H.: Textbook of Physiology, p. 110. Philadelphia and London, W. B. Saunders Co., 1908.

Nerve fibers are divided into two great groups: the efferent fibers, which carry impulses out from the nervous system to the peripheral tissues (skin, muscles, etc.), and the afferent fibers, which carry impulses inward from the peripheral tissues to the nerve centers.

Some of the efferent fibers, carrying impulses outward from the centers, are also called motor nerve fibers. If these fibers end in muscles, the effect of their impulses is to produce muscular contraction. If they end in glands, they cause a secretion, depending on the kind of tissue with which the nerve fiber is connected. Some afferent fibers, bearing impulses inward to the nerve centers, are also called sensory fibers, because in many instances these impulses reach the brain and give rise to sensations of various kinds. Often, however, these inward carried impulses do not reach the brain in consciousness, but are manifested as reflex actions, such as the movements of the heart, intestines, etc. These reflex activities constitute a fundamental part of our nervous system, but we may for the time being leave them out of account.

(b) The Location of Nervous Fatigue

The question at once arises how our intricate nervous system succumbs to fatigue and how such fatigue is manifested. It obviously cannot easily be measured and registered, like muscular fatigue, upon a revolving drum. Laboratory study of nervous fatigue has been beset with enormous difficulties and the unsolved problems are many. There is profound disagreement among scientists as to what part of the nervous system first succumbs after excessive exertions.

We know that the nerve fibers themselves—carriers of energy—are apparently not readily subject to fatigue. That is, they can conduct impulses to the peripheral tissues almost indefinitely. Varied experiments have proved that their normal functional activity may be carried on to an almost indefinite extent without causing fatigue. In these experiments the underlying idea has been to stimulate the

nerve continuously, but to interpose a block somewhere along the course of the nerve, so that the impulses shall not be conducted to the muscle experimented upon. This is obviously necessary because otherwise the muscle would become fatigued, and there would be no way to distinguish between fatigue of the muscle or of the nerve fiber. By the use of curare, a South American arrow poison, the passage of the electric stimulus to the muscle is blocked, the poison affecting the terminations of the nerves, or motor end-plates, as they are called, and preventing their transmission of impulses to the muscles. By the use of curare, then, the sciatic nerve has been continuously stimulated for as long as ten hours.* When the effects of curare were removed (which can be accomplished within a few minutes) the nerve was found to be still conducting, the muscle responding. Thus, nerve fibers are practically unfatiguable.

It has long been supposed that while nerve fiber is proved highly resistant, the central portion of the nervous system is extremely susceptible to fatigue. It has been thought that after prolonged muscular activity the brain and spinal cord tire first, before the muscle. Thus, after a finger muscle has become so fatigued by the ergograph that it can no longer voluntarily lift a given weight, it can be made to do so by electric stimulation. The muscular mechanism is apparently still in working order, at least for a space of time. After a longer or shorter period, even the given electric stimulus cannot cause the muscle to contract, and the individual's curve of fatigue drops after electric stimulation in very much the same way that it does in voluntary contraction. Apparently the muscle has not entirely lost its power of contraction when it can no longer voluntarily contract. According to this theory, what seems to be muscular fatigue is in reality nervous fatigue, fatigue of some part of our nervous system.

Laboratory experiments upon animals show that after prolonged activity demonstrable histologic changes take

* Howell, Wm. H., op. cit., p. 111.

place in the nerve cells of the brain and spinal cord.* Mosso drew attention to the marked modifications in the brains of exhausted birds. He gives a delightful account of his experimental dove cote and of his fatigue tests upon military carrier pigeons provided by the Italian Ministry of War. He studied also the changes and characteristics in wearied migrating birds, such as the quail which arrive each year in great numbers from Africa upon Italian shores. Exhausted by their journey, hundreds are killed, dashing themselves in plain daylight against walls and houses. Either they are too much exhausted to see these bright objects which seem to fascinate them from afar, or their exhaustion is too great to allow them to raise themselves even one extra yard in their rapid flight. Mosso ascribed their impaired vision to the cerebral anæmia found in birds exhausted by long flights. Later in his book he shows how profoundly a diminished circulation of the blood affects the functions of nervous tissue in man. A few seconds' pressure upon the eyelid, lessening the blood supply, is enough to distort vision, and a diminution of the brain's blood supply is followed by loss of consciousness after six or seven seconds.†

Other more recent experiments throw some measure of doubt upon these demonstrations of fatigue in the central nervous system. Some investigators suggest that the first part of our neuro-muscular mechanism to tire after sustained contraction is the nerve-ending in the muscle, or motor end-plate.‡

* Hodge, C. F.: *Amer. Jour. of Psychology*, 1887–1888, Vol. I, p. 479; 1889, Vol. II, p. 376. *Jour. of Morphology*, 1892, Vol. VII, p. 95.
Vas, Fr.: Archiv für mikroskopische Anatomie, 1892, Vol. XL, p. 375.
Mann, Gustav: *Jour. of Anatomy & Physiology*, 1894, Vol. XXIX, p. 100.
Lugaro, E.: *Lo Sperimentale*, Sezione biologica, 1895, Vol. XLIX, p. 159.
Eve, F. C.: *Jour. of Physiology*, 1896, Vol. XX, p. 334.

† Mosso, Angelo: La Fatica. Milano, 1891. English translation, pp. 1–29, 72 and 73. New York, Putnam, 1904.

‡ Müller, G. E.: Zeitschrift für Psychologie und Physiologie der Sinnesorgane, 1893, Vol. IV, p. 122.
Müller, Robert: Wundt's Philosop. Studien, 1901, Vol. XVII, p. 1.
Hough, Theodore: *Amer. Jour. of Physiology*, 1901, Vol. V, p. 240.
Storey, Thomas A.: *Amer. Jour. of Physiology*, 1903, Vol. VIII, p. 355.
Joteyko, Mlle. J.: Fatigue. Richet's Dict. de Physiologie. Paris, 1904, Vol. VI, p. 29.
Woodworth, R. S.: N. Y. University Bulletin of the Medical Sciences, 1901, Vol. I, p. 133.

Scientists themselves disagree as to the precise nature and localization of nervous fatigue. Little is known as to the production of fatigue substances by the central system. It may even be that central nerve cells are less readily susceptible to fatigue than has been supposed and that they succumb only to a really high degree of exertion. Yet it should be clearly understood that the uncertainty of scientists as to the precise localization of nervous fatigue does not touch the acknowledged fatiguability of *some portion*, not yet completely verified, of our nervous endowment. Thus Professor Frederic S. Lee, one of the physiologists who inclines most strongly to the belief that central cells are more resistant than has been supposed, specifically states that "nervous fatigue is an undoubted fact,"* and that, "we cannot deny fatigue to psychic centers," though "the intimate relations of central and peripheral fatigue are much in need of exact experimental study."†

Moreover, it is not essential to our present inquiry to know whether muscle or nerve substances tire first, or exactly what part of our nervous system is first affected. These still unsolved problems may not go unmentioned in any account of the study of fatigue. They are the unanswered questions fronting the scientist, for whom the "humblest catabolic product" must be a challenge, until he has plucked out the mystery of its composition and effect. For our purposes it is enough to realize that nervous fatigue, be it central or peripheral, exists, a relentless fact, reacting inexorably upon our total health and life. It is the form of fatigue most fraught with possibilities of mischief. For when fatigue affects the nervous system, it attacks what has been called the "administrative instrument of the individual," which "directs, controls and harmonizes the work of the parts of the organic machine and gives unity to the whole."

When that administrative instrument is impaired by overwork and exhaustion, formidable forms of disease appear

* Op. cit., *Science*, N. S., Vol. XXIX, No. 744, p. 525.

† Op. cit., Harvey Lectures, 1905–06, p. 180.

which we shall subsequently view so far as they may be traced to industrial causes. But first we must proceed to examine how nervous fatigue is manifested in the laboratory.

6. THE RISE AND FALL OF WORKING CAPACITY

(a) Work Continued Under Fatigue Costs More Effort

One of the most valuable contributions of the Turin school was in proving graphically the nervous strain in overwork.

It is a fact familiar to every one that work done after fatigue has set in requires much greater expenditure of nervous energy than work done before fatigue. This is illustrated by the simple act of holding up a weight in outstretched arms after they have become tired. It is shown in the so-called tension of the will needed to complete a difficult task, the unmistakable sense of effort in "keeping-up."

Mosso showed that a much stronger electric stimulus is required to make a wearied muscle contract than one which is rested. He devised an apparatus, the ponometer, which records the curve of nervous effort required to accomplish muscular action as fatigue increases. He showed that the nerve centers are compelled to supply an ever stronger stimulus to fatigued muscles. As the muscle tires and accomplishes less work, more and more energy must be supplied for contraction. In the language of the laboratory, the ponometric curve follows a course which is the inverse of the ergographic curve; or, more intelligibly put, effort increases with fatigue.

In another way, and as impressively, Maggiora showed how much greater effort is needed to make wearied than fresh muscles work. He found that after his finger muscles were exhausted by a series of contractions in the ergograph, he had to allow a two-hour rest before they were completely rested. If he diminished this period, and allowed only one and one-half hour's rest, the muscle was insufficiently restored and could not do as much work as when thoroughly rested.

By analogy it might be supposed that if the work were lessened, the period of rest might be reduced in the same proportion; that if Maggiora cut in half the work which required two hours' rest, he would need only one hour to recover entirely from a shorter series of contractions. But experiment proved, surprisingly, that even less rest was needed after the shorter period of work. If work is reduced by one-half, the period of necessary rest can actually be reduced half or three-quarters as much again. Thus, if 30 contractions exhaust the finger muscle so that it needs two hours' rest, 15 contractions require not one hour but only a half-hour for recuperation. In other words, the expenditure of energy in the last 15 contractions, after fatigue has set in, is much greater than the energy expended in the first 15 contractions, since the last set of contractions exhaust the organism much more than the first set.

Moreover, the tracings of work done in the second set of contractions are much smaller than the first tracings; the output falls off, as we say of industrial work. Hence strain, or work done after fatigue has set in, not only costs more effort but accomplishes less. The last 15 contractions are decidedly smaller, while the effort to keep up costs the organism four times as long a rest for recuperation.

The ergographic record shows also the remarkable recuperative effect of rest taken at the critical moment before exhaustion is reached. For if work is stopped after the first set of contractions, before the muscle is completely exhausted, it accomplishes just twice the amount of work which was produced when the muscle was pushed to the actual point of exhaustion. As Mosso puts it:*

"Our body is not constructed like a locomotive which consumes the same quantity of coal for every kilogrammetre of work. When the body is fatigued, even a small amount of work produces disastrous effects. . . . . The workman that persists in his task when he is already fatigued not only produces less effective work, but receives greater injury to his organism."

* Op. cit., English translation, pp. 152 and 157.

(b) The Nature of Training

Professor Treves at Turin, a follower of Mosso, throws further light upon the injuries due to an excessive run upon nervous energy. It is a wellknown fact that in muscular exertion there is a marked gain in efficiency during the first period of work. In the muscular contractions of men as well as of animals, the curve of fatigue rises before it begins to fall. That is, before fatigue begins to diminish the muscle's power of contracting, there is a period during which the muscle gains strength at every effort and is able to raise the weight to a higher and higher level. This upward progression of the curve is known to physiologists as the staircase, or

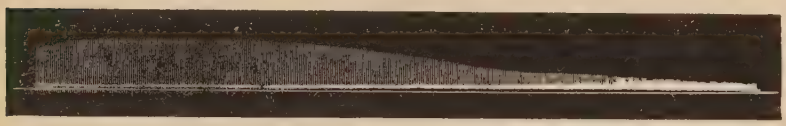

Fig. 6

Series of contractions of a frog's sartorius muscle, excised and stimulated at intervals of two and one half seconds. Each successive vertical line is the record of a single contraction. The contractions at first increase in extent, this stage constituting the treppe, and later decrease, this stage constituting fatigue.

"treppe." The treppe means that, in its early stages, the working power of muscle is augmented. Its physiological irritability, or power of responding to a stimulus, increases, so that the same stimulus results in greater contractions. After a certain period the treppe is at its height, and contraction continues at its maximum until the development of fatigue causes it to diminish and fail.

In the study of isolated muscle these three general though not sharply defined stages of work may be observed. First, the treppe, when working power is on the increase and excitability is growing; second, the period when the muscle is in its best working condition, its excitability highest; and third, the period when fatigue products clog

the muscle more and more until contraction is finally forced to cease.

These three general stages of work, graphically shown in the contractions of isolated muscle, are familiar to every one in ordinary experience. It is an epitome of life at which we are looking—a picture of human work drawn without perspective. Everyone knows that in every long-continued task, the first stage is one of "limbering up"; then we gradually reach the plane where our working power is at its maximum (more or less variable to be sure), until fatigue inclines it unmistakably downward towards our minimum—the zero of exhaustion.

Training is of inestimable value in all work, as well as in sports. It increases our working capacity by practically retarding the onset of fatigue for a longer or shorter period. It does this by making the tissues more or less resistant to those poisons which, as we have seen, are generated in action and accumulate unduly in overexertion.

Training, like the fatigue which it combats, has a true physiological basis, and physiology explains its virtue as clearly as it does the essential injuries of fatigue. It is a wellknown fact that the body adapts itself in extraordinary measure to even large quantities of poisonous drugs, when they are taken in gradually increasing doses. So, also, it adapts itself to moderate and increasing amounts of the fatigue poisons. Now, proper physical training provides graded and increasing exercises, and these increasing exercises, by producing successively larger amounts of fatigue poisons, inure the tissues gradually to such poisonous products. This resistance of tissue to the depressant action of our self-generated poisons is the most important element in all training or practice.

The athlete is enabled by training to undergo exertions which would kill an ordinary untrained man. Training even saves a certain amount of nervous energy by a more ready coördination of muscles and by calling upon a smaller number of muscles than are used by the untrained man.

The question, however, arises whether in intensive regular labor which makes great demands on the organism, muscular efficiency may not be bought at too dear a cost of nervous energy. Overtraining is as unmistakable a phenomenon as training, and the pathologic effects of overtraining are not confined to athletes. We have seen that the strain of the wearied muscle to keep up, after fatigue has set in, costs more effort and accomplishes less than the work of unwearied muscle; we have seen that nervous stimulation must increase as working capacity declines. Now Professor Treves asserts that when muscles have attained their greatest strength, the nervous energy at their command will not have grown in proportion. He says:*

"According to my experience, it has not been found that training has as favorable an effect upon energy as upon muscular strength. . . . This fact explains why muscular training cannot go beyond certain limits and why athletes are often broken down by the consequences of overexertion. And this fact teaches also the practical necessity of preventing women, children, and even adult men from becoming subjected to labor which, indeed, a gradual muscular training may make possible but at the price of an excessive loss of nervous energy which is not betrayed by any obvious or immediate symptom, either objective or subjective. While the individual works, the reserves of disposable nervous energy in the neurones which preside over muscles diminish much more rapidly than the production of work which may keep to the normal level. . . . In spite of this diminution, if circumstances continually demand intense and constant work, the stimulus will continue to be sent to the muscle with the intensity necessary to accomplish the purpose. . .

"Here we have an arrangement of things which is of inestimable value to man in the production of work; but this beneficent provision becomes injurious to the dynamic equilibrium of the organism as soon as it is irrationally employed. It is this that needs to be avoided in the practical organization of industry."

*Thirteenth International Congress of Hygiene and Demography, Brussels, 1903, Vol. V, Sec. IV, pp. 6–7. Treves, Dr. Z. (University of Turin): Dans quelle mesure peut-on par des méthodes physiologiques étudier la fatigue, ses modalités et ses degrés dans les diverses professions.

One step more and we reach the terminus of our analysis. We have seen that the curve of muscular work normally begins to decline after it has reached its maximum, when the fatigue products clog the muscles excessively. Now it is a fact of vast consequence to our total health that with nervous fatigue the curve of work often does not descend as normally it should. Nervous fatigue may indeed seem to increase our working capacity temporarily. Most persons are familiar with what is colloquially called "working on one's nerves," when nervous fatigue instead of depressing our working capacity, as it normally should do, stimulates it to greater activity. The temporary increase in efficiency is, of course, illusive, though it may for a while lead to a really heightened capacity. But at too dear a cost! After a longer or shorter period the false stimulation breaks like a bubble, leaving the worker nervously unstrung and dropped abruptly down to a plane of efficiency far lower than normal fatigue should have declined to.

This form of nervous over-stimulation thus conceals from the worker the oncoming of fatigue, so that he may approach the stage of exhaustion before he is aware of the fact. Consciousness of fatigue does not at all keep pace with the progressive exhaustion of the nervous mechanism, with its apparently heightened irritability or power of response.

At this point the scientific interpretation of industrial problems advocated at the outset of this study becomes obvious enough. A flood of light is thrown upon the intricate injuries of speed, overtime, piece-work, and the like industrial requirements. For if fatigue be due to demonstrated chemical action, removable only by proper intervals of rest; if overfatigue or exhaustion results from the accumulation of chemical fatigue products and the destruction of energy-yielding material in nerve and muscle tissue; if strain or labor carried on after fatigue has set in is proved more exhausting than simple work, and if muscular training outruns nervous strength,—then the need for the shorter

workday rests upon a scientific basis. Science makes out its case for the short day in industry.

No one has expressed this mission of science to labor and industrial legislation with more discernment than M. Hector Denis, of the Belgian Council of Labor. In a few eloquent sentences he has transformed the dry business of law-making into a calling of insight and the imagination.*

"Man has a new right," he says, "the right to leisure and rest, as well as work. . . . The history of labor legislation can be given in two words: The right to rest is inherent in man's physiological structure. From this follows the social need to do away with the exhaustion resulting from overwork and to conserve working power, the most precious possession of a nation. . . . Science traces out a path for the modern lawmaker. His difficult but glorious mission is to accomplish the normal synthesis of these two inalienable rights springing from the very laws of life—the right to use one's working powers and the right to conserve them."

7. THE GREATER MORBIDITY OF WOMEN

We have now examined some of the features of our common physiologic life, persistent, though varying with our ages, our states of health, our native intensities, our individual psychological motives and checks. Before proceeding to examine some industrial operations and their demands on human energies; it remains to point out the special susceptibility to fatigue and disease which distinguishes the female sex, *qua* female.

This physiological differentiation between men and women is important in this study because women's physiological handicaps make them subject more than men to the new strain of industry. If now the health of women in industry is shown to be specially open to the inroads of fatigue and disease on account of their physical make-up, they clearly need the protection of special laws.

* Royaume de Belgique. Conseil Supérieur du Travail, 6e Session. 1901–1902. T. I., Fasc. II. Le Repos Hebdomadaire, pp. 168 and 169.

It goes without saying that the fundamental fact which distinguishes women physiologically from men, is their particular sex function—the bearing of children. Their anatomy and physiology is adapted for this primal function, whether or not it is ever to be realized, whether or not they are ever to become mothers of children. The unmarried as well as the married woman, therefore, is subject to the physical limitations of her sex, and each suffers alike from those incidents of industrial work most detrimental to the female reproductive system, such as overstrain from excessive speed and complexity, prolonged standing, and the absence of a monthly day of rest. These and similar conditions are common to most industrial operations and they are particularly harmful to women.

In addition to their susceptibility to injuries of the generative organs, working women have been found more liable than men to disease in general. There is a consensus of opinion among those who have longest observed girls and women at work, that the burdens of industrial life press much more heavily upon them than upon men. Wherever statistics of the morbidity of both workingmen and workingwomen exist, the morbidity of women is found to be higher. Such statistics do not exist in this country, but they are to be found abroad in the records of foreign sickness insurance societies.* The two most important facts to be noted are women's higher morbidity when compared with men in the same occupations, and their longer duration of illness, measured by the number of days lost from work.

More than twenty years ago the eminent Swiss writers, Schuler and Burckhardt, the one a factory inspector and the other professor of hygiene at Bâle, showed† that in cotton mills where both sexes were employed the relative morbidity of men and women was as 100 : 128. This was in the spin-

* See *Journal of the American Medical Association*, Vol. LII, No. 2, p. 138. Editorial, Jan. 9, 1909.

† Schuler, Dr. Fridolin, und Burckhardt, Dr. A. E.: Untersuchungen über die Gesundheitsverhältnisse der Fabrikbevölkerung der Schweiz, p. 34. Aarau, Sauerländer, 1889.

ning rooms. In the weaving rooms the morbidity of women was even higher, being as 139 : 100.

These figures have since been confirmed and amplified by other authorities. The most recent authoritative American book on workingmen's compensation gives the morbidity figures of German insurance societies during a period of years. These figures concern men and women *not* of the same trades. The number of cases of sickness among men is greater than among women, but the duration of women's illnesses is longer. Hence, what is technically called the co-efficient of morbidity, that is, the "duration of sickness per member each year," is higher for women than for men.*

PER CENT AND DURATION OF SICKNESS IN GERMAN SICKNESS INSURANCE SOCIETIES, 1888–1907

		1888	*1892*	*1903*	*1904*	*1905*	*1906*	*1907*
Cases of sickness per year per 100 insured.	Men	33.5	36.8	38.3	40.9	41.4	39.4	42.7
	Women	28.8	31.1	33.0	35.4	35.0	33.4	35.6
Average number of days of sickness per case	Men	16.6	17.0	18.1	18.7	18.7	18.5	18.5
	Women	17.7	18.3	21.9	23.2	23.5	24.1	23.4
Days of sickness per annum per 100 insured	Men	555.6	626.6	695.3	762.1	775.9	728.6	788.7
	Women	508.3	569.7	720.4	822.9	927.9	804.7	833.1

The same thing is shown in a recent Swiss report regarding the morbidity of men and women in the Swiss mutual insurance societies.†

* Frankel, Lee K., and Dawson, Miles W.: Workingmen's Insurance in Europe, pp. 240 and 241. Russell Sage Foundation Publication. New York, Charities Publication Committee, 1910.

† Die Gegenseitige Hilfsgesellschaften in der Schweiz im Jahre 1903, Berne, 1907.

"Among 100 insured men an average of 26.76 received sick relief; but among 100 women only 24.26. The men who received sick relief averaged 23.55 days of illness; the women averaged 32.46.

"The women, therefore, showed a lower percentage of relief but a longer average duration of sick time, and as a result of these two circumstances the average morbidity of the women is higher than that of the men—7.87 as against 6.30."

A German authority gives somewhat less recent but interesting comparative figures of German and Austrian sickness insurance societies, showing in each case the same longer duration of women's illnesses. For each 100 persons the days of illness per person averaged as follows: In the German society referred to, the men averaged 21.6 days lost through illness, the women averaged 24.4 days so lost. In the Austrian society the men lost on an average 16.5 days as compared with an average of 18.8 days lost by the women.*

Thus are women physiologically handicapped by a greater general liability to disease, and a peculiar susceptibility to injuries of the generative organs. In a word, they are less resistant to fatigue than men, and their organisms suffer more gravely than men's from the strains and stresses of industrial life, to whose newer aspects we are next to turn.

* Prinzing, Dr. Friedrich: Handbuch der Medizinischen Statistik, p. 110. Jena, Fischer, 1906.

III

THE NEW STRAIN IN INDUSTRY

WHAT, then, are the special forms of overstrain found in modern industry, viewing industrial conditions, as was our premise, from the physiological point of view? In a brief sketch of this vast field it will be possible to single out only a very few features for comment. We can do no more than glance, as it were, at some of the innumerable processes which directly or indirectly feed the machinery of the world, supplying man's needs and luxuries.

Of those elements in industry which are most characteristic and which make the greatest demands on human energies, we may select the following: speed and complexity, monotony, piece-work, and overtime. Let us attempt to gauge the part played by these factors in a few trades, so as to have before us some concrete examples of industrial things as they are. Other fatiguing influences in machine work, such as noise and the mechanical rhythms, will of necessity come within the scope of our brief analysis, as well as the now recognized relation between fatigue and the incidence of industrial accidents.

1. SPEED AND COMPLEXITY

(a) The Telephone Service

Let us begin with our first factors, speed and complexity. Measured by these, few trades can equal in their demands upon the human organism an occupation newly open to the girls and women of our generation and practically new to the last decade. This is the ubiquitous telephone service,—that network of wires which spans continents and binds together,

as never before in history, at least the outward and visible activities of men. Indeed, we could scarcely picture to ourselves the spectacle of modern life without a telephone at every hand, servant of every whim and desire, and by the same token, a new tyrant that few can escape.

Now, one part of this mechanism, one link in the chain between two speakers, is the girl's voice which answers every call by day or night, a link, to most persons, as disembodied and automatic as the receiver on its hook.

We are to look a little more closely at this girl's conditions of work. They are special to her business, but not unfairly typical of the new strain in all industry. Two recent official investigations* give us an unusual abundance of facts by which to gauge that phase of the work in which we are here interested: its effects on the health of the workers; its cost, not in money, but in the outlay of woman's physiological powers.

The whole telephone business is new, dating from 1876. Originally it employed only men and boys. In 1907, according to a report of the Bureau of the Census, there were 76,638 female operators in the United States as against 3,576 male operators. Something like twice as many persons were employed in other positions as clerks, mechanics, officials, and so on. We shall confine ourselves here to the work of the women operators.

These thousands of "telephone girls" whose ages vary from sixteen years upward, are in a sense picked workers.† In most cities, the companies require for the efficiency of the service, a physical examination of all applicants, and seek to exclude girls and women suffering from eye, ear, throat, or heart trouble. Most companies have also an educational

* Report of the Royal Commission on a Dispute Respecting Hours of Employment between the Bell Telephone Company of Canada, Ltd., and Operators at Toronto, Ontario. Ottawa, 1907.

Investigation of Telephone Companies made by the United States Bureau of Labor. Senate Document No. 380, 61st Congress, 2nd Session. Washington, 1910.

† In one large city, out of 6,152 applicants, 2,229 were refused. (Senate Document No. 380, p. 19.)

requirement, accepting no applicants who have not completed the fifth or grammar grades of the public schools. Most companies also give a month's training in a telephone school where applicants learn the mechanism of the switchboard and the manifold duties of telephone operating.

These picked workers also receive, on the whole, more intelligent care than other industrial workers. Fair ventilation of workrooms, rest rooms, luncheons provided at cost, and free, hot beverages at lunch time,—all these elementary "welfare" provisions have been found useful in keeping up the operator's efficiency and are therefore provided by most companies.

So much we have on the credit side of the business, physiologically viewed. What, then, is on the debit side? To gauge this, we must briefly describe what telephone operating is. The most concise description of this intricate subject involves a certain amount of technical detail, since the simplest form of telephone connection requires eleven separate processes on the part of the operator. Yet in no other way than by tracing these separate operations can we intelligently gauge the tax of this occupation. The nature of the work, the large and daily growing number of girls and women engaged in it throughout the country, and the fact that prominent physicians in one community have expressed themselves forcibly upon its physical effects, warrant our devoting material attention to these otherwise unrelated details.

The center of the telephone system is the "exchange." On entering the operating room of an exchange one sees perhaps one hundred young women seated side by side, on adjustable chairs facing the switchboard, which extends in the form of a semicircle or "U" around three sides of the room. The switchboard looks not unlike a continuous line of upright pianos in front of which the girls are seated. Only, the key-board or flat shelf extending out from the six-foot high vertical face of the board is usually wider than a piano key-board, varying in width from six inches to a foot. The

vertical face of the board is marked off into sections and panels, honey-combed with holes. Each hole in the lower panel of the vertical board is the terminal of a subscriber's telephone, and the holes are so distributed that each operator has before her a certain number of telephones for which she is directly responsible. Just over each hole, or "answering jack" as it is called, there is a glass-covered orifice, containing a miniature incandescent lamp, which glows whenever a subscriber lifts his receiver from the hook. This light, together with a clicking sound which she hears through her receiver whenever she "listens in," signals to the operator that she is being called.

On the upper half of the vertical board known as the "multiple" are the terminals, or jacks, of all telephones connected with the exchange, by means of which the operator can connect her subscribers with the persons whom they wish to reach. These upper jacks are repeated or "multiplied" over and over throughout the switchboard, usually once in each section, or each six feet, so that the operator can reach any line for which she is asked.

On the horizontal shelf or key-board, extending out from the vertical face of the board, there are two rows of small metal plugs, attached to cords, the points of the plugs alone showing above the surface of the board. A little nearer to the operator, on the shelf, are two rows of tiny glass-covered signal lamps similar to those over the subscribers' jacks described above, and still closer to the operator, on the shelf, there is a row of small levers or keys.

Such is the apparatus, together with the operator's individual "set,"—a receiver strapped over her ear and a mouth-piece or transmitter suspended so that she can conveniently speak into it, leaving both hands free. When a subscriber lifts his receiver to call "central," the signal light immediately flashes out at the terminal of his line on the switchboard. The operator thereupon gets into communication with the subscriber by inserting one of the plugs with its attached cord into the hole or jack correspond-

ing with the glowing light. She then throws forward one of the levers known as the "listening key." This connects her with the calling subscriber and extinguishes the signal light. She asks, in the wellknown phrase, "Number, please," and upon receiving a reply makes the desired connection as follows: She inserts the companion end of the cord which she has used (the cords are in pairs with a plug at the end of each), into the proper hole on the upper "multiple" portion of the board, bearing the number of the desired person. She also rings up this second person by pressing another lever, at the same time discontinuing her listening key.* Then she makes her first entry upon a prescribed slip, in order to register the call.

Thus two subscribers are in communication. But there must be some way for the operator to learn automatically when the conversation is ended. Therefore each pair of cords have connected to them two of the tiny signal lamps. When the operator inserts the plugs into the jacks their corresponding lights begin to glow. As soon as the called subscriber lifts his receiver the signal light goes out, showing the operator that her ringing has been answered. The lights remain out during conversation, but as soon as the subscribers have finished and hang their receivers, the lights above the companion plugs again begin to glow. This warns the operator to sever the connections and to clear the jacks for the next call.

Thus the telephone girl must be continually at the top-notch of expectancy, watching intently for the flash of the signal lights, responding instantly to the clicking sounds heard whenever impatient subscribers move their hooks up and down, making and severing connections with all the speed she may.

The mere statement of these operations in the simplest form of telephone connection, gives us some insight into the prodigious strain of this occupation upon the special senses,—

* In New York City, the operation of ringing and listening is done with one key.

sight, hearing, touch,—as well as the muscular exertion of reaching high up and to the side. We cannot here enter into the complex modifications of the general system described above (as when a subscriber is called whose telephone terminates in a different exchange), and the many different color signals which the operator must instantly recognize when they flash before her, such as, toll calls, nickel machine calls, and many others.

As regards the physical effects of the work, we are fortunately not thrown upon surmise but have expert medical testimony to draw upon. This is available in the remarkable report of the royal commission appointed to investigate a dispute between the Bell Telephone Company of Canada and their operators at Toronto. The 26 physicians who testified had examined the exchanges and the nature of the work. We must postpone until our next chapter their detailed statements as to the detriment to health from overwork in the taxing telephone service, the specific injuries to the sense organs, and the disastrous reactions upon the operator's nervous system. Here it is enough to say that after weighing the physicians' testimony and recommendations, the royal commission, with some misgivings, permitted the total number of working hours for women switchboard operators to be fixed at seven hours, broken by several relief periods and spread over a period of nine hours.

The commission took pains to say, however, that in view of the medical evidence before them, a seven-hour workday for telephone operators seemed to them "still too long," and they concluded:

> "In our opinion a day of six working hours spread over a period of from eight to eight and three-quarter hours, and under as favorable conditions as may be expected in an exchange doing a large business, is quite long enough for a woman to be engaged in this class of work, if a proper regard is to be had for the effect upon her health."*

* Two hours' work, ½ hour relief, 1½ hours' work, 1 hour intermission, 2 hours' work, ¼ hour relief, and 1¼ hours' work. Report of the Royal Commission, pp. 99–100.

Such being the royal commission's mature conclusions, we turn to consider the same work in the United States, as set forth in the recent report of the United States Bureau of Labor. The methods of operating here and in Canada are the same.

Where the royal Canadian commission found seven hours "still too long" and recommended six hours, we find the *average* hours of work in the United States reported as eight and a half hours per day. But this is one of the averages which hide the truth, and, in practice, owing to various reasons, the actual working hours are much longer. Telephone operators are divided into various working groups, or "tricks," who come on and go off duty at widely varying terminal hours, and have their luncheon and relief periods at separate times. During certain busy hours of the day, known as "peak of the load," morning and afternoon, the service is vastly increased and requires an increased number of operators. These various arrangements of work are necessary because the telephone exchange is never closed. The fires of Vesta burn day and night! They must be tended unceasingly.

If the *average* working hours are eight and a half per day, then many girls must work longer than that each day, as others work less. Thus, to mention merely at random some daily hours far in excess of the average eight and a half, in 1910 the night operators of the Bell Telephone System were reported working fifteen hours in Springfield, Missouri; twelve hours in Kansas City, Missouri; nine hours in New Orleans, Louisiana, and in Dallas, Texas. Day operators were reported as employed ten hours net in Kansas City, and nine hours net in Atlanta, Georgia. And the day operators of the American Telephone and Telegraph Company were reported as employed nine hours net in Kansas City and New York City.*

The requirement of overtime work makes the workday even longer, although the hours officially reported already

* Senate Document No. 380, 61st Congress, 2nd Session, pp. 37 and 38.

by far exceed the maximum deemed compatible with health by the Canadian physicians.

The custom of requiring overtime in most companies lengthens the workday by adding from a few minutes to two and a half hours. The American report is full of references to this pernicious practice. In one city, for instance, where overtime is "not above the average," the company reports that, on overtime, their day operators are on the premises twelve and a half hours and on duty ten hours. Overtime is stated to be an "integral part" of the schedule of hours in a number of telephone companies.

"Operators not only are asked to take their turn in working extra hours, but in some companies a regular extra period is assigned to each operator for certain days each week. She is virtually compelled to do this extra work, lest by refusing she incur the displeasure of her chief operator, or get the reputation of shirking her share of work."*

The report of the commission to investigate the conditions of working women in Kentucky, states that in one exchange where the regular hours were nine in one day, an operator worked 39 hours overtime during the first two weeks of November, 1911, in addition to her daily work. The report adds: "This is not an exceptional case. Many other girls are working as long hours."†

One of the most vicious forms of overtime is known as "working through"; that is, working on both a day and a night shift. Thus, in one company, where the shift known as the "split trick operators" usually work eight hours (from 11 a. m. to 2 p. m., and from 4 to 9 p. m.), an operator who "works through" is employed thirteen and one-half hours (from 11 a. m. to 2 p. m., and again from 4 p. m. to 7 the next morning), with four and one-half hours off duty during the night.

* Senate Document No. 380, p. 110.

† Report of the Commission to Investigate the Conditions of Working Women in Kentucky, p. 30. Louisville, December, 1911.

"The next day the operator reports as usual. In one case a fifteen-year-old girl (who claims to be sixteen) is reported 'working through' four times in two weeks. While this is not a regular thing," says the report, "it is done with sufficient frequency to be worth noting."*

In connection with overtime work, nothing is more striking than the extreme variation in the number and percentage of operators employed on overtime in various cities. In New York City, for instance, it is reported that less than one-fifth of one per cent of the operators work overtime in a given period. In Boston and Washington, also, the number is small, while in New Orleans and Omaha over 90 per cent of the operators worked overtime during the same period. In Cleveland, Louisville, and Nashville, over 85 per cent, in San Francisco and Dallas, Texas, and Atlanta, Georgia, over 60 per cent of the operators are reported to have worked overtime.†

Besides overtime, several other hardships of the telephone service which are prominent in the American report, and greatly intensify the strain of this occupation, need mention. One of these is the almost universal requirement of Sunday work twice a month. This hardship speaks for itself and scarcely needs comment. It means that for most operators the day of rest, which may not be lost without physiological retribution, comes only once a fortnight. Sunday and holiday work clearly cannot be avoided in the telephone service, but as the report remarks, only two large companies "have discovered that this need not mean seven days' work each week."

A second acute hardship of the service concerns the relief periods, usually fifteen minutes long, which are designed to break the morning and afternoon work. The Canadian physicians laid supreme stress upon the importance of such reliefs as absolutely indispensable periods of recuperation, considering even twenty minutes off duty too short to compensate for a two-hour period of work; but in many com-

* Senate Document No. 380, pp. 111–112. † Ibid., pp. 90–91.

panies these reliefs are regarded by the management as favors to be given or withheld at will, rather than necessities. At any "rush" when most needed, the reliefs are most often curtailed. Of 331 girl operators interviewed by agents of the Bureau of Labor, 126, or more than one-third, reported that they had either no relief or received it only on request.

"Where this system obtains, girls feel a reluctance to ask for relief; sometimes they feel that to do so is to jeopardize promotions, and the new operators who need it most are usually the very ones who fail to get it, because a feeling of strangeness or timidity keeps them from asking favors."*

A third hardship of the telephone service, as disastrous to the operator's health as the loss of the "relief," is known as "excess loading." This concerns the number of calls handled by each operator per hour. Most of the experts for the companies consider 225 calls per hour the "breaking point of efficiency," that is, the number which cannot be greatly exceeded for many minutes without injuring the service rendered to the public. As the report rightly states:

"It is safe to say that the breaking point of the operator's health is not far from the breaking point of efficient work."†

"She is expected to give all the subscribers the quickest possible service in the order in which their calls come in, but when several signals come at once and others come before these can be cared for, the order of calls is necessarily lost and the effort is concentrated merely on clearing the board, or catching up. It must not be forgotten that with each signal there is not only the flashing of a small light in the operator's eyes, but there is a clicking sound in her ears through the receivers fastened to her head. So when the impatient subscriber, angry because his call has not been answered, moves the receiver hook of his 'phone up and down rapidly, he flashes the signal light in front of the operator, and produces a click in her ears every time the hook goes up and down. The consciousness of numbers of people waiting for call connections she is unable to make, and that each one is growing more impatient each second; that a supervisor is standing

* Senate Document No. 380, p. 33. † Ibid., p. 60.

behind her either hurrying her or calling her numbers to be taken by other operators; that a monitor may plug in and criticise any moment,—these, with the height of up-reach and length of side-reach, go to form the elements of strain on the operator who is 'overloaded.'"*

Yet, in spite of its known effect upon health and efficiency, an inexcusable degree of overloading exists in a wide range of cities, chiefly in the south and west. Accepting an average of 225 calls per hour as the breaking point, many exchanges were found exceeding that number for all operators in the exchange. The table below gives some of the cities found exceeding not only this accepted limit, but exceeding 275 calls per hour.†

TELEPHONE EXCHANGES IN FIVE CITIES WHERE CALLS EXCEED 275 PER HOUR

Company	*City*	*Exchange*	*Hour Ending*	*No. of Calls*
Mo. and Kansas Tel. Co.	Kansas City, Mo.	West	9 P.M.	281.7
Pac. Tel. and Telegraph Co.	Los Angeles, Cal.	East	6 P.M.	285.2
			7 P.M.	317.0
			8 P.M.	303.0
	San Francisco, Cal.	Market	11 P.M.	279.0
		Franklin	3 P.M.	308.3
	Seattle, Wash.	Queen Ann	6 P.M.	283.2
So. Bell Tel. and Telegraph Co.	Birmingham, Ala.	Main	11 P.M.	301.5

(b) Speed in the Needle Trades

Turning now to other industries in which women and children are employed in great numbers, we find a similar

* Ibid., p. 56.

† Ibid., p. 61.

state of affairs. Let us next consider the typically feminine occupation of sewing, the traditional sphere of womankind.

It is undeniable that a great saving of human energy was accomplished when the first power machines replaced the ordinary foot sewing machine. Long hours of work at foot sewing machines had been responsible for many female disorders and had wrecked the lives of many women. But we must not close our eyes to the cost of the new order.

Mention has already been made of the increasing perfection of motor sewing machines. Some kinds, as we have seen, now carry 12 needles, others set almost 4000 stitches a minute. Let any observer enter a modern roaring, vibrating workroom where several hundred young women are gathered together, each at her marvelous machine, which automatically hems, tucks, cords, sews seams together, or sews on the embroidery trimming of white underwear. In the well equipped shops each girl has a brilliant electric light, often unshaded, hanging directly in front of her eyes over the machine. Her attention cannot relax a second while the machine runs its deafening course, for at the breaking of any one of the 12 gleaming needles or the 12 darting threads, the power must instantly be shut off. The roar of the machines is so great that one can hardly make oneself heard by shouting to the person who stands beside one.

What must be the physiological effect of work so carried on during long hours? In New York state, for instance, the great center for the manufacture of women's stitched white wear, which is supposed to have been perfecting its laws for women since their first enactment twenty-six years ago, young girls who have reached their sixteenth birthday may legally be employed at power machines twelve hours in the day during five days in the week.* Illegally, they are employed even longer at "rush" seasons.

The strain of this industry is further intensified by two other factors, which will be discussed subsequently more at length, but which must not go unmentioned here. Pay so

*See page 4 for new law enacted in 1912.

low that it makes a less than living wage, and great irregularity of employment, exist in the stitching trades in combination with the excessively long hours, possibly because of them. These factors, at any rate, make an evil combination,—upper and nether millstones between which the health of the girls and women in this trade is almost inevitably ground. It is true that some girls earn high wages at piece-rates during the busy season, reaching $18 and $20 per week. But the busy season is short—varying from two to three months for the winter, and again for the summer trade, and the year's earnings of the best paid workers fall short of decent self-support. The great majority earn wages so low and so precarious (from $4.00 to $8.00 or $10 per week), with weeks and months of non-employment, that were it not for the testimony of trustworthy witnesses it would be scarcely credible that women living away from home and wholly dependent upon themselves, could support life on such a yearly income.*

These allied problems of low wages and irregularity of work may seem to lead too far afield from our special interest in industrial overstrain. But they are closely knit to it, and in a dozen ways are related to the length of the day's work. With over-long hours, even with the ten-hour day, all that double burden of household work added to wage work, which no workingwoman can wholly escape, becomes more burdensome. Whether she lives at home, her own or her parents', and helps in the household, or lives alone and is thrown on her own resources for clothing and clean linen as well as for food and for some sort of habitat, she must find time for some domestic duties after her wage work is done.

Two traditional economies of women, unattained by men, are washing their linen, and mending, if not making, their own clothes; and after a working day of reasonable length, working girls can and do achieve these economies without too great a tax upon their endurance. But when overtime

* Clark, S. A., and Wyatt, Edith: Making Both Ends Meet. New York, Macmillan, 1911. (These articles are based upon a study made for the National Consumers' League of the income and outlay of more than 200 working girls, living away from home, in New York City.)

confines them, as it does in the stitching trades, until nine and ten o'clock at night, irregularly, for weeks in succession, we find such pitiable items as those disclosed in the study above referred to, of 200 working girls who live away from home in New York City. In one case of extreme overwork, out of a total yearly expenditure of only $41.85 for all clothing, an unhappy overworked girl spent $15.60 for stockings. She lacked time and strength for the humblest care of her wardrobe, darning stockings, and instead, continued all year to buy two pairs a week, at 15 cents each. In another case a similar disproportionate expenditure of $23.52 for 24 shirtwaists at 98 cents a piece, out of a whole year's expenditure of $194.50, resulted also from an exhausted girl's lack of time and spirit for mending. The remarkable folly of such expenditures makes them none the less piteous evidences of the exhaustion of these girl operators, alternately overworked at high power machines and then left destitute of work and health.

Many other ways might be shown in which low wages together with the excessive length of the workday contribute to the new strain of industries. Physiologically considered, as we shall see, the worst effect of low pay, especially low piece-rates such as prevail in the stitching trades, is their incentive to a too great intensity of work, and to a feverish speed on the part of the operators.

(c) The Textile Industry

In the sewing trades, then, the elements of speed and complexity are growing by leaps and bounds. The same thing is evident in another great trade, employing women and children, the textile industry. Here the increasing strain upon the workers, due to improved equipment, may be described by one of the officials whose daily work brings them into contact with the conditions of which they speak.

"For the first time women were interviewed who were running twelve and sixteen Draper looms. These machines

are practically a recent addition, and are so arranged that the filling in the shuttle is changed automatically, thus enabling them to go at a greater rate of speed and with less interruption. The women are not expected to clean, oil or sweep. This matter was quite fully discussed and the complaint made that the work was too hard, but that they tried to do it, as they were dependent upon their positions and they knew there were plenty of foreign men waiting for their places. Where a woman has been accustomed to tend a six-loom set, with the Drapers she is given from twelve to sixteen, which extend over quite an area. There is no time for sitting during the day, as when employed on the other looms. One woman said she could not sleep at night after running these vast machines, and many have had to give up their places and find other work.

"This marks another evolution in the machinery world. Years ago, a woman tended two slowly running looms. Later, as the hours of work grew less, the number of looms was increased to four and six, and now with the Drapers, an operative is expected to look out for twelve or sixteen."*

Even this statement does not fully cover the facts. It is not uncommon in New England mills for one weaver to tend from 16 to 24 Northrup or Draper looms. The number of looms attended by one weaver has even risen as high as 36 in southern and, less frequently, in northern mills. But the output is said to be less satisfactory than when each worker runs a smaller number of looms.

It is true that the new automatic attachments of the Draper loom enable weavers to run a larger number of such machines with no greater effort or fatigue than was formerly involved in running a smaller number of old looms. But this is true only up to a certain point. According to a liberal estimate, after a weaver is required to attend more than 18 looms, the advantages of the new devices are more than counterbalanced by the increase in numbers, and the strain of the occupation becomes too great. Thus, for instance, the strain upon the weaver's attention was greatly lessened by such an automatic invention as the recent warp stop-motion, whereby

* Report of the Maine Bureau of Industrial and Labor Statistics, 1908, pp. 42–43.

power is automatically turned off and the loom stops at breakage of the warp. But when one weaver has perhaps 24 looms to tend in place of the former eight, the strain upon attention in watching for the automatic stoppage of the looms is even greater than before. Since the weaver's wages depend upon the continuous running of the machines, the strain is continuous.

The space over which 24 looms extend requires also much more walking on the part of the weaver, since she may be called to and fro to any one of the looms in turn, to any place in the alley or alleys along which they are ranged. Yet the physical and nervous cost of running three times as many looms as before the Drapers were invented, has been so little regarded that the manufacturers of the loom prophesy* an even greater increase in the number of machines per worker. They see no reason why in time one weaver should not run 50 looms, provided only that a sliding seat be arranged along the alley to relieve her from constant walking to and fro. If this hopeful prophecy is not fulfilled, it will probably be due to the unsatisfactory economic results of the machinery rather than to any consideration of the human agents.

2. MONOTONY

Besides speed and complexity of operation, work with the Draper looms illustrates also a third factor in industrial strain, mentioned at the outset; that is, monotony of occupation. Weavers formerly varied their work by cleaning and oiling the machines, fetching their own filling, etc. Now all these things are done by less skilled hands, while the weaver, in order to keep up with the number of her looms, attends strictly and continuously to running the machines.

In all trades, operations tend to become more and more machinelike in regularity and sameness. Labor tends to become more and more subdivided, each worker performing steadily one operation, or part of one operation.

* Labor Saving Looms, p. 112. Third Edition. The Draper Co., Hopedale, Mass., 1907.

This kind of single-minded concentration of the workers upon their immediate tasks obviously makes for speed and perfection of output. It is an integral part of the new industrial efficiency of our day and it saves constant waste, both of time and of materials. But we must also consider the reverse side of the picture. If concentration and subdivision are part of the new efficiency they are part, too, of its new strain. So far as the workers are concerned, subdivision and concentration are added hardships of the long day. For they lead to that monotony which results from the endless repetition of the same operations, and against which the human spirit innately revolts. Monotony, indeed, may make highly taxing to our organism work which is ordinarily considered light and easy. This may be observed in many different occupations.

(a) The Canneries

Thus, in the canneries, which are increasing from year to year in every fruit and vegetable growing state from Maine to California, the chief fatigue of the work is due to its combined speed and monotony.

We may well examine a little in detail some of the ordinary cannery processes, because they illustrate the new strain of industry which we are considering, and because the physical and nervous tax of these occupations has been little recognized throughout the country. A comparatively short span of time has sufficed to see evolved from the yearly preserving and jelly pots of our mothers' generation the highly speeded, intricate machinery of the modern canneries. Indeed, the transformation of the industry is not yet complete. Canning has still the double disadvantage of a household and a factory business. Cannery workers suffer from all the pressure and speed of great commercial establishments. They suffer also from the canner's inadequate methods of management, inherited from the original home work which preceded the canneries. When each family provided for itself a winter's supply of fruits and sweets, there was little hardship in a

few days' work at picking and preserving. It is popularly supposed that canning today is very much the same, and that it affords farmers' wives and children, in certain parts of the country, pleasant holiday work and pin money during the summer.

But in reality this is far from true. We may take as typical, in spite of local differences, the canneries in New York state, since a recent official investigation* describes the conditions there, and they happen also to be familiar to the writer.

Any person who is not familiar with these establishments must imagine them situated sometimes in open country, sometimes on the outskirts of small towns, throughout the central and western part of New York state. A cannery usually consists of one central building, where the machinery is supposed to be located, and adjoining sheds where the work of preparation—such as stringing beans, husking corn, hulling strawberries, peeling beets, tomatoes, etc.—is supposed to be performed.

On the whole, the new strain in the canning industry has come, as in most industries, with the introduction of machinery. It is true that even the familiar work of preparing fruits and vegetables for canning has become more taxing to the health of the workers, on account of the greater speed at which it is done, owing to the very low piece-rates paid for this work.† But the main change since canning was taken out of private kitchens has been due to the machine processes. Two of the most important of these are known as "sorting" and "capping."

For "sorting" vegetables, conveyors or endless moving bands carry past the girls and women seated or standing at the sorting tables, a ceaseless stream of peas or beans to be picked over for broken or spotted vegetables, thistle buds, or other imperfections. Hour after hour, from morning until

* Annual Report of the Bureau of Factory Inspection. Report on the Work of Children and Women in Canneries. New York State Department of Labor, 1908.

† One-half to one and one-half cents per pound for stringing beans, etc.

night (except for stoppages from breakdowns and irregularity of supply), the workers' eyes and attention must be intent upon the moving stream before them, shoving back the tide with one hand if it comes too fast, while with the other they pick out the imperfections which must not be allowed to pass into the cans. The work is sufficiently easy, so far as muscular exertion goes, but the tax upon eyes and attention is severe, and even after considerable experience, women complain of the nausea and dizziness resulting from the monotonous examination of the moving surface of the conveyors.

The work of the "cappers" is more severe than that of the "sorters" on account of the greater speed at which the conveyors are run. When the cans have been filled with fruits or vegetables, and covered with brine or syrup, they are ready to be hermetically sealed. The conveyors carry them from the automatic "filler" to the sealing or capping machine. One to three "cappers" are employed, who place the metal caps or covers on the filled cans in rapid succession as they file past swiftly to be soldered. The capping girl sits close to the red-hot sealing irons, usually holding a number of caps in her hand, and dropping them monotonously, one at a time, upon the cans as they pass swiftly on the tireless conveyor, at a rate varying from 54 to 80 cans per minute. It is said that a second capper is usually employed on machines operating faster than 60 cans per minute.

The fatigue of the work at the conveyors or sorting tables is increased by the unnecessarily constrained and uncomfortable positions to which the girls are subjected. The tables are rarely at a right height to make this work as easy as possible. Sometimes they are so high that the workers must stand all day; sometimes so low (3 feet from the ground) that the workers cannot sit with their knees under the tables, but work in twisted and awkward attitudes. Moreover, the seats themselves are totally inadequate. According to the New York report, of about 1,400 girls and women engaged in sorting peas and beans at various factories in the summer of 1908, only about 180 had chairs to sit upon. The others

were supplied with inadequate boxes, crates, stools, or benches. During a long workday, not infrequently exceeding twelve hours, the difference between being comfortably seated at work or crouched upon an improvised support is self evident. Yet these two operations of "capping" and "sorting" employ more women in the canneries than any other machine operations. The New York report states that about 1,400 persons were employed at "sorting" peas and beans alone. Two hundred and twenty-seven girls were employed in "capping" peas, beans, corn, tomatoes, and fruits.

Besides the work of "sorting" and "capping," another machine operation is highly taxing. This is feeding the corn cutters, and it is also performed by women. The workers feed ears of corn into the cutters at topmost speed.

"It is very rapid work," says the New York report,* "the machine is very noisy, kernels of corn are flying everywhere, and everything is damp and sticky from the juice of the cut corn. Of the 61 women employed at this work, 41 were standing. The cutters are operated at high speed and as 'their capacity is only limited by the rapidity with which the feeder can place the ears in the feeding trough,'† the operators are expected to work, and do work, at high tension."

Such is the nature of the most important machine operations at which women are employed in the canneries.

It is true that the working *year* is short. Canning is, perforce, a season trade, though the season lasts much longer than merely a few weeks, as the canners would have us suppose. In establishments which can peas, beans, and corn only, the season is from about the last week of June until about the middle of October; that is, between three and four months. Canneries where fruit is packed have a longer season: strawberries ripen in June and apple packing is often carried on into December, so that the season lasts between six and seven months.

* Op. cit., p. 374.

† "Circular of sales house distributing one of the leading makes of corn cutters."

Even longer duration of employment is reported by the latest government investigation of canning establishments in Maryland and California. Agents of the United States Bureau of Labor studied the conditions of employment in both city and country canneries. The government states that 10 Baltimore canneries, operated during twenty-nine to fifty-two weeks in the year; that is, between seven months and an entire year. Four of the canneries reported a range of fifty weeks or over. Five city canneries in California varied in duration of operation, but four of the five had a season of more than twenty-nine weeks; that is, over seven months. Four country canneries in California varied between nineteen and one-half to twenty-four weeks in operation.*

Moreover, our studies in fatigue have shown us that overwork is not balanced by idleness, when the physiological limits have been over-run. Girls in the critical period of adolescence, and women who are overstrained during half the year, or even during a quarter of the year, may be permanently wrecked in health. That they are so overstrained has been shown by repeated private investigation of New York canneries. During the summer of 1911, women were observed working fifteen hours a day during successive days.

According to the Bureau of Labor Bulletin, in 10 Baltimore canneries employing 2,214 women the hours of labor reported by the employers themselves include "days of 17½, 16½, 15½ hours, and weeks of 93, 91½ and 81 hours."† In California, the employers themselves report "days of 18, 15 and 13½ hours, and weeks of 96½, 90 and 83 hours."

In the cannery occupations, eyestrain is an added tax, but in many kinds of work it is the sheer repetition of uninteresting samenesses that makes the work fatiguing. So in the making of paper boxes, the infinite repetition of mechanical movements—steadying a strip of paper in a box-covering machine, guiding it by a gauge and replacing the

* Bulletin of the U. S. Bureau of Labor, No. 96, September, 1911. Hours of Women's Work in Maryland and California, pp. 355 and 393.

† Ibid., pp. 355 and 393.

strip by another when it runs out—continues for ten hours in the day, or longer at "rush" periods. In a factory where hinges are made, girls spend a long day's work putting 50 hinges a minute through a machine, lifting a hinge out, slipping it into place, replacing it by another hinge, unvaryingly —and the list of such occupations might be indefinitely extended.

(b) Shoe Making

Even in trades which require highly skilled workers, the processes of manufacture are so subdivided, and are so reduced to the simplest units, that a man or woman spends his or her entire working life performing over and over a fractional part—sometimes less than one-hundredth—in the construction of a whole.

No trade illustrates better this minutest subdivision of work than the making of shoes. Ten years ago the United States Industrial Commission, in its report on the hours of labor in various industries, took occasion to mention specifically the greater intensity of labor "in the boot and shoe factories where the operator is required to handle thousands of pieces in a day and guide them through the machine." In the decade which has passed since this was written, the speed and subdivision of work at shoe machinery have been greatly increased. We may obtain an idea of the extraordinary specialization in this trade at present when we learn that a well-built shoe has passed through the hands of about 100 workers and through the operations of about 60 different kinds of shoe making machinery.* These figures do not include the workers in the stitching room, where a separate force sews together, on specially constructed sewing machines the pieces of leather and lining which make up the so-called "uppers." From the stitching room, the flat, sewed uppers are sent to the making or "bottoming" room, where they are shaped over lasts fastened to the soles, and made up into the forms which we recognize as shoes.

* Goodyear Welt Shoes, How They Are Made. United Shoe Machinery Co., Boston, 1909, p. 11.

Of all these machines and operations which go into the making of shoes, we will examine two a little more closely. The first of these is the "upper trimming" machine, through which the shoe passes on its way to completion.

The stitched upper has already been pulled over the wooden last, which gives the shoe its shape, by an extraordinarily ingenious machine that pulls the leather with pincers evenly and tightly down over the last, driving in a tack at every pull, so as to hold the upper exactly in place on the last. In pulling the leather over the bottom edge of the last, there is naturally a surplus amount of leather left at the rounded toes and some along the sides of the shoe. This is "crimpled" or fulled in against the insole. Now the trimming machine, which we are considering, trims off this surplus leather fulled in at the toes and side, so as to make the bottom as smooth as possible before the sole is sewed on. The trimming machine consists of a sharp knife edge, operating constantly against a sharp edged revolving top. The man who works the machine stands, holding upside down somewhat below the level of his eyes, the partly made, still unsoled shoe. He turns it skilfully and rapidly on the revolving top, against whose sharp edge the second knife-blade operates, cutting off all the surplus crimpled leather. The work is extremely rapid and absolutely uniform. But it takes skill and close attention. The machine could easily cut off too much, or could cut into the upper, if the swift handling of the shoe were not exactly correct. The workman must be skilled, but all that constitutes his work is daily to revolve in his two hands about 2600 pairs of shoes, or 5200 single shoes. The expert workers are able to trim off that number of uppers daily in this machine. It is not surprising that such monotony of occupation should be a factor in fatigue. For the work is unvaried. The man who operates the upper trimmer does nothing else. His skill and speed have been acquired by the extremest specialization. He performs, perhaps, less than one-hundredth part in the making of a single shoe, and he does not know how to operate, or

would be extremely awkward at, the machine next him which performs a different hundredth fraction of the manufacture.

This is men's work in shoe making. The next example is women's work. It is the operation of the new eyeletting machines, which move with what the makers rightly describe as "bewildering rapidity." The girl who operates this machine sits in front of it, guiding the flat sewn uppers, which are to have eyelets punched into them, somewhat as she would guide the material in a sewing machine. She adjusts levers and various mechanical contrivances to regulate the speed and spacing of the eyelets. Women maintain that they can work faster than men at this machine, because they can keep a supply of uppers ready in their laps, while men are obliged to keep their supply of uppers next to them and have to make an extra motion of the arm to pick them up. The output of the machine varies according to the spacing of the eyelets. Men's shoes, which have only four or five evenly spaced holes, naturally go more quickly than women's, which have often as many as 12 holes irregularly spaced. An expert worker at the eyeletting machine can finish 2000 pairs of ladies' shoes in one day, although this amount, like that given above, is probably 20 per cent higher than the average worker's output.* Again, the work is skilled, extremely swift, and monotonous. The workers do not have the opportunity of relaxing the particular kind of attention which their machine requires, for each one is a specialist in her own fractional field only. It is the acme of subdivision.

Astonishing as are the material results in output, this minute division of labor and the unrelieved monotony of work which it brings must be counted in any effort to appraise the new strain of industry. Not machine workers only, mere feeders of larger automata, but hand workers too, suffer from the blight of monotony. The girls and women who pack the innumerable small objects which must be wrapped before

* Statement in a letter from a representative of the United Shoe Machinery Co., March 4, 1912.

they reach the retail stores—such as all sorts of glass objects, lamps, crackers, candy, and other food-stuffs—have an occupation of unrelieved monotony. It requires no more judgment or skill than to feed a machine, only speed and the indefinite repetition of dull, mechanical movements.

3. PHYSIOLOGY OF MONOTONY

It goes without saying that monotony of work, of which these are random examples, cannot be avoided in our industries. It is a part of their development, and even when ingenious machines are invented to do work previously done by hand, the running and feeding of such machines often provides only another form of monotonous work for the human agent. With subdivision, and the loss of craftmanship, monotony of work in greater or less degree is inevitable, and may well be accepted as such. For when once monotony is recognized as a real hardship, and as in itself a source of fatigue, rational means of relieving it may be sought, in shortening hours of monotonous labor and alternating work of different kinds. An interesting example is given by a German factory inspector of excessive fatigue resulting from light, but monotonous, work on corset steels, which was relieved by periodical changes of work for the employes in question.* Enlightened employers in various industries have found such alternations of work practically beneficial in stemming fatigue.

From our physiological point of view, this is entirely logical, because the strain of monotony is not due merely to the distaste for work and the aversion it engenders. Monotony of occupation is a true factor in inducing fatigue, because it has a true physiological basis, which can briefly be made clear. We know that with repetition and sameness of use there results continuous fatigue of the muscle or organ used. So, too, with the nerve centers from which our motive power

* Quoted by Dr. Emil Roth. Ermüdung durch Berufsarbeit. Fourteenth International Congress of Hygiene and Demography, Berlin, 1907, Vol. II, Sec. IV, p. 614.

springs. We must bear in mind that the special functions of the brain have separate centers. Thus, there is a center for hearing, another for sight, another for speech, etc. When certain centers are working continuously, monotonously, from morning to night, day by day and week by week, it is physiologically inevitable that they should tire more easily than when work is sufficiently varied to call upon other centers in turn.

The monotony of so-called light and easy work may thus be more damaging to the organism than heavier work which gives some chance for variety, some outlet for our innate revolt against unrelieved repetitions. Monotony often inflicts more injury than greater muscular exertion just because it requires continuous recurring work from nerve centers, fatigue of which, as we have seen, reacts with such disastrous consequences upon our total life and health. The evils of monotony illustrate again how closely all the functions of our life are bound up together; how the physical and nervous and psychic parts of us react and interact upon one another. Aversion from a monotonous grind of work, the effort of the will to "keep up," requires just so much more nervous stimulus from already tired nerve centers.

4. NOISE

In both the needle and textile trades, which we have taken as types of work involving speed and complexity, fatigue is the more quickly induced by other attendant influences which are common to most machine work. One of these fatiguing influences is the noise of the machinery.

The fatiguing effect of the roar of machinery is chiefly due to its influence upon the faculty of attention. Mental fatigue is "characterized pre-eminently by a weakening of the powers of attention."* Voluntary attention is essentially a selective process, a "focalization and concentration of consciousness"† upon one thing or a few from among the multi-

* Lee, op. cit. Harvey Lectures, 1905–06, p. 180.

† James, William: The Principles of Psychology. Advanced Course, p. 426. New York, Henry Holt and Co., 1899.

plicities, physical and mental, in whose midst we live. There is thus in attention a sensation of effort, and fatigue of attention is in direct proportion to the continuance of the efforts and the difficulty of sustaining them. Now, under the influence of loud noise, attention is distracted and the difficulty of sustaining it increased.

The term reaction time, as is well known, is used for the minute interval between the occurrence of some external phenomenon and the signal of its having been perceived by any given individual. This interval is, as a rule, almost infinitesimal. It is counted in hundred-thousandths of a second, yet individuals differ markedly in the speed of their reactions. In laboratory experiments these infinitesimal differences are exactly measured by the use of Hipps' chronometer, a stop watch constructed to mark the thousandth part of a second. The laboratory experiments confirm what we know from everyday life, that attention increases, and fatigue of attention decreases, our promptitude of reaction. Thus in a game of tennis, for instance, or in any sport where the reaction must be instant, we fail to make prompt returns as soon as attention is in any way distracted and we are off guard. Measured by the chronometer, most people take about 134 thousandths of a second before responding with the hand to a touch on the foot, but fatigue of the attention may double the length of this reaction, prolonging the interval to as much as 250 thousandths of a second.

Now, further laboratory study shows how noise, like fatigue, retards the time of reaction. Mosso quotes* an experiment which showed that when an organ was played, reaction time was increased from 100 thousandths of a second to 144 thousandths, before the subject of the experiment showed that he felt a touch upon his left hand. This retardation took place in spite of a greater intensity of attention, and whenever the disturbing sound ceased, the time of physiological reaction became as before. James quotes more careful, detailed studies of Wundt which disclose the

* Mosso, Angelo: La Fatica. English translation, pp. 204 and 205.

same kind of retardation in reaction through the influence of disturbing noise.*

* James, William, op. cit., pp. 427–432.

"Under this head, the *shortening of reaction-time*, there is a good deal to be said of attention's effects. Since Wundt has probably worked over the subject more thoroughly than any other investigator and made it peculiarly his own, what follows had better, as far as possible, be in his words.

'I made experiments in which the principal impression, or signal for reaction, was a bell-stroke whose strength could be graduated by a spring against the hammer with a movable counterpoise. Each set of observations comprised two series, in one of which the bell-stroke was registered in the ordinary way, whilst in the other a toothed wheel belonging to the chronometric apparatus made during the entire experiment a steady noise against a metal spring. In one-half of the latter series (A) the bell-stroke was only moderately strong, so that the accompanying noise diminished it considerably, without, however, making it indistinguishable. In the other half (B) the bell-sound was so loud as to be heard with perfect distinctness above the noise.

		Mean	*Maximum*	*Minimum*	*No. of Experiments*
A (Bell-stroke moderate)	Without noise	0.189	0.244	0.156	21
	With noise....	0.313	0.499	0.183	16
B (Bell-stroke loud)	Without noise	0.158	0.206	0.133	20
	With noise....	0.203	0.295	0.140	19

'Since, in these experiments, the sound B even with noise made a considerably stronger impression than the sound A without, we must see in the figures a direct influence of the disturbing noise on the process of reaction. This influence is freed from mixture with other factors when the momentary stimulus and the concomitant disturbance appeal to different senses. I chose, to test this, sight and hearing. The momentary signal was an induction-spark leaping from one platinum point to another against a dark background. The steady stimulation was the noise above described.

Spark	*Mean*	*Maximum*	*Minimum*	*No. of Experiments*
Without noise....	0.222	0.284	0.158	20
With noise	0.300	0.390	0.250	18

'When one reflects that in the experiments with one and the same sense the relative intensity of the signal is always depressed (which by itself is a retarding condition) the amount of retardation in these last observations makes it probable that *the disturbing influence upon attention is greater when the stimuli are disparate than when they belong to the same sense.* One does not, in fact, find it particularly hard to register immediately, when the bell rings in the midst of the noise; but when the spark is the signal one has the feeling of being coerced, as one turns away from the noise towards it.'" (Wundt. Physiol. Psych., 2nd ed. II, pp. 241–5.)

Thus, noise not only distracts attention but necessitates a greater exertion of intensity or conscious application, thereby hastening the onset of fatigue of the attention. A quite uncounted strain upon this easily fatigued faculty results among industrial workers, such as girl machine operators, when the deafening intermittent roar of highly speeded machinery adds its quota to the tax of a long day's work. The roar is not even continuous enough to sink into monotony. With each stoppage and starting of a machine, it bursts out irregularly.

The subject of noise in industrial establishments is usually dismissed with the remark that the workers "get used to it," and doubtless, in many occupations, the workers themselves are scarcely, or not at all, conscious of any increased application on their part, due to the noise. But, in the main, the process of getting used to it involves precisely that increased intensity of nervous effort, that "feeling of being coerced," of which Wundt speaks in the laboratory experiments, and which, as we have seen, is most favorable for the approach of exhaustion.

5. FATIGUE AND INDUSTRIAL ACCIDENTS

Fatigue of the attention and lack of muscular control are important in another connection hitherto little regarded. It has been shown to play a subtle part in the occurrence of industrial accidents. The statistics of all countries which have recorded the hours at which such injuries occur prove that, other things being equal, the accidents increase progressively up to a certain time in the morning and again in afternoon work.

In estimating the accidents of working people, we are too much accustomed to dwell only upon the concrete objects of danger, such as the unguarded machinery, or the prodigious size and weight and speed of industry's mechanisms; or the atmospheric conditions of work such as intense heat and glare, or cold and dark, and the like. But besides all these

external factors and their effects, we must reckon with the human subject himself, and the reason why, among so many ever-present chances of danger, so many are escaped as well as succumbed to.

Here, again, the causes of immunity or the reverse cannot easily be isolated. The worker's total makeup,—his coolness, his experience, his native quickness of reaction, his *state of being*, physical and mental, taken as a whole, determine his chances. Yet we know that even in the healthiest organism the products of fatigue accumulate with progressive hours of work; we know that our promptitude of reaction rises and falls with the freshness of our attention; that nothing is more potent than fatigue to increase reaction time and develop muscular inaccuracies.

Hence, when we find the number and ratio of accidents increasing up to a certain point with each successive hour of work during the morning, falling towards zero at the noon hour and again rising to a maximum in the afternoon, it is reasonable to ascribe the increase in large part to the effects of fatigue, direct and indirect.

In a general way, the increase of accidents late in the day has long been known. These "melancholy details" were urged as arguments for shortening the workday by Lord Shaftesbury and the earliest English reformers.* But it has been only within comparatively recent years that any statistics on the hours of incidence have become available. The data from various states and countries are not in complete accord and show various discrepancies. The statistics quoted below should be regarded merely as initial studies. Yet they are significant, notwithstanding their defects, because they reveal tendencies too uniform and consistent to be the work of chance.

The most valuable and complete statistics come from Germany, the first country to adopt, in 1884, a comprehensive system of accident compensation on a national scale. Germany was one of the first nations to require that the hours

* Hansard's Parliamentary Debates. 3rd Series. March 15, 1844.

of the incidence of accidents be reported. The Imperial Insurance Office has made a practice of publishing, at ten-year intervals, special studies of industrial accidents for which compensation has been paid to working people under the national accident insurance system. Such investigations were made for the industrial insurance associations in 1887, 1897, and 1907. The following table shows that during the year 1887 the highest accident rate, for all industries, occurred between ten and twelve in the morning and between five and six in the afternoon.*

NUMBER AND PER CENT OF ACCIDENTS DURING THE YEAR 1887, BY HOUR OF THE DAY (GERMANY)

Hours	Accidents		Hours	Accidents	
	Number	*Per Cent*		*Number*	*Per Cent*
Morning			Afternoon		
6 to 7 . . .	435	2.82	12 to 1 . . .	587	3.81
7 to 8 . . .	794	5.16	1 to 2 . . .	745	4.84
8 to 9 . . .	815	5.29	2 to 3 . . .	1037	6.73
9 to 10 . . .	1069	6.94	3 to 4 . . .	1243	8.07
10 to 11 . . .	1598	10.37	4 to 5 . . .	1178	7.65
11 to 12 . . .	1590	10.31	5 to 6 . . .	1306	8.48

The latest German statistics give the number of hours worked by injured persons on the days of their accidents,† and show that the accident rate is highest during the fourth and fifth hours of morning work.‡

* Quoted from the Amtliche Nachrichten des Reichs-Versicherungsamts, 1890, in the 24th Annual Report of the United States Commissioner of Labor. Workmen's Insurance and Compensation Systems in Europe, Vol. I, p. 1134.

† Amtliche Nachrichten des Reichs-Versicherungsamts, 1910. I. Beiheft I. Teil. Gewerbe-Unfallstatistik für das Jahr 1907, pp. 329–335. Bulletin of the United States Bureau of Labor No. 92, Jan., 1911. Harris, Henry J., Ph. D.: Industrial Accidents and Loss of Earning Power: Germany's Experiences in 1897 and 1907, p. 50.

‡ See table on next page. It has been suggested that the German custom of allowing about 15 minutes for afternoon lunch (Vesperpause) at 4 o'clock or later is responsible for the decrease beginning with the eighth hour of work. See Harris, Henry J., op. cit., p. 49.

NUMBER AND PER CENT OF PERSONS INJURED OR KILLED DURING THE YEAR 1907, BY NUMBER OF HOURS OF WORK ON THE DAY OF THE ACCIDENT (GERMANY)

Number of Hours Injured Persons had been at Work	All Industries, etc.	
	Number Reported	*Per Cent*
Less than 1	3,939	4.94
1 to 2	6,885	8.63
2 to 3	7,351	9.21
3 to 4	9,004	11.28
4 to 5	9,739	12.20
5 to 6	8,106	10.16
6 to 7	6,462	8.10
7 to 8	6,908	8.66
8 to 9	6,817	8.54
9 to 10	6,041	7.57
10 and over	8,539	10.71
Total	79,791	100.00

In France, too, the distribution by hours, of accidents occurring among French workmen, has been studied. Between 1904 and 1907, Professor Imbert of the University of Montpelier, in conjunction with French factory inspectors, investigated accidents occurring in sundry occupations such as the building trades, metal and wood-working trades. They also showed graphically the hours of accidents occurring among 140,407 workers affected during the year 1903 by the French accident compensation law.* In all these studies the general features of the curves were the same. The summit was reached between 10 and 11 a. m. and again between 4 and 5 p. m.

Similar studies showing similar results were published in 1907, by the Belgian factory inspectors† and by two Italian

* Revue Scientifique, 4e Juin, 1904. Ibid., 24e Septembre, 1904. Ibid., 21e Octobre, 1905. Bulletin de l'Inspection du Travail Fasc. 3–4. Paris, 1906.

† Royaume de Belgique. Rapports Annuels de l'Inspection du Travail, 1907, p. 206.

physicians who investigated more than 5,000 accidents occurring in machine shops of Italian railroads during a period of four years.*

So far as concerns the United States the study of work injuries has been so much belated that the significance of their times of incidence has not been noted until very recently. As late as the year 1909 the writer was unable to learn of any American investigations into this subject. Since then several have appeared. In its report for the year 1909–10, the Wisconsin Bureau of Labor published a brief table of accidents, according to their distribution by hours.†

Some unpublished accident statistics of the Illinois State Department of Factory Inspection for the year 1910

NUMBER OF ACCIDENTS DURING THE YEAR 1910, BY HOUR OF THE DAY (ILLINOIS)

Morning	*Accidents*	*Afternoon*	*Accidents*
7 to 7 : 59.....	79	1 to 1 : 59.....	111
8 to 8 : 59.....	120	2 to 2 : 59.....	156
9 to 9 : 59.....	193	3 to 3 : 59.....	227
10 to 10 : 59.....	246	4 to 4 : 59.....	260
11 to 11 : 59.....	257	5 to 5 : 59.....	145
12 to 12 : 59.....	49	Other hours.....	289

were quoted in a recent study of industrial accidents in the *American Journal of Sociology*.‡ The author states that of the accident reports examined, 2,687 gave a fairly accurate description of what had happened preceding the accidents, and of these, 2,203 or 82.2 per cent "conceivably might have been avoided if the injured, or the fellow servant who was the

* *Il Ramazzini*. Giornale Italiano di Medicina Sociale. Anno. I. Fasc. 10–11. Oct., 1907. Pieraccini, Prof. G., and Maffei, Dr. R. (R. Arcispedale di S. M. Nuova, Firenze): Le stagioni, i giorni, le ore nel determinismo degli infortuni del lavoro.

† 14th Biennial Report of the Wisconsin Bureau of Labor and Industrial Statistics. 1909–1910. Part II, p. 78.

‡ Bogardus, Emery S.: The Relation of Fatigue to Industrial Accidents. *American Journal of Sociology*, University of Chicago Press. Volume XVII, Nos. 2, 3, and 4. (September and November, 1911, and January, 1912.)

NUMBER AND PER CENT OF ACCIDENTS BY HOUR OF THE DAY
(United States—Some Comparative Statistics)

Hours	Cotton Mills				Metal-works	
	126 Mills 1 Year		*1 Mill 8 Years*		*Total*	
	No. accidents	*Per cent*	*No. accidents*	*Per cent*	*No. accidents*	*Per cent*
6 to 7 a. m.	73	6.19	63	8.22	..	..
7.01 to 8 a. m.	95	8.05	68	8.88	486	7.81
8.01 to 9 a. m.	126	10.68	82	10.71	677	10.87
9.01 to 10 a. m.	**161**	**13.64**	90	11.75	**860**	**13.81**
10.01 to 11 a. m.	128	10.85	**114**	**14.88**	763	12.25
11.01 to 12 m.	78	6.61	43	5.61	491	7.89
12.01 to 1 p. m.	58	4.92	9	1.18	241	3.87
1.01 to 2 p. m.	78	6.61	63	8.22	602	9.67
2.01 to 3 p. m.	98	8.30	67	8.75	676	10.86
3.01 to 4 p. m.	**126**	**10.68**	**77**	**10.05**	**716**	**11.50**
4.01 to 5 p. m.	90	7.63	57	7.44	511	8.21
5.01 to 6 p. m.	59	5.00	33	4.31	203	3.26
6.01 to 7 p. m.	7	.59	..	..	..	..
7.01 to 8 p. m.	3	.25	..	..	..	..
Total	1,180	100.00	766	100.00	6,226	100.00

Hours	General Manufacture				Grand Total	
	Indiana 3 Years		*Wisconsin*			
	No. accidents	*Per cent*	*No. accidents*	*Per cent*	*No. accidents*	*Per cent*
6 to 7 a. m.	..	..	..	..	136	0.91
7.01 to 8 a. m.	546	11.31	76	4.02	1,271	8.53
8.01 to 9 a. m.	492	10.19	126	6.67	1,503	10.09
9.01 to 10 a. m.	**603**	**12.49**	227	12.01	**1,941**	**13.04**
10.01 to 11 a. m.	469	9.71	**245**	**12.96**	1,719	11.54
11.01 to 12 m.	338	7.00	208	11.00	1,158	7.78
12.01 to 1 p. m.	183	3.79	49	2.59	540	3.63
1.01 to 2 p. m.	441	9.13	126	6.67	1,310	8.80
2.01 to 3 p. m.	481	9.97	213	11.27	1,535	10.31
3.01 to 4 p. m.	**598**	**12.38**	**240**	**12.70**	**1,757**	**11.80**
4.01 to 5 p. m.	480	9.95	229	12.12	1,367	9.18
5.01 to 6 p. m.	197	4.08	151	7.99	643	4.32
6.01 to 7 p. m.	..	..	..	..	7	.05
7.01 to 8 p. m.	..	..	..	..	3	.02
Total	4,828	100.00	1,890	100.00	14,890	100.00

cause of the accident in some cases, had had accurate muscular control." Of the 2,203 accidents which might have been avoided, the time was given at which 2,162 had occurred, and again showed the summit of the accident curve between 10 and 12 o'clock in the morning and 4 and 5 in the afternoon.

The federal investigation of wage-earning women and children includes a study of accidents among about 14,000 metal workers, male and female, and more than 75,000 cotton mill workers. For purposes of comparison it includes the Wisconsin table and some unpublished statistics from the Indiana Bureau of Factory Inspection. "Here," says the report,* "are four sets of figures, collected by different agencies in different parts of the Union at different times and covering different industries, each agency working independently of the others. Yet the figures thus gathered show . . . striking similarity." Omitting the hour from 6 to 7 a. m., the accident rate is shown to be highest during the third and fourth hours of work.

Such, in brief, is the testimony of the statistics. It is true that most of these studies of accidents are open to various criticisms. They are not sufficiently full and specific to be scientifically accurate. They do not state the actual number of workers employed at each hour of the day. More workers are employed at some hours than at others; hence the increased number of accidents during the third and fourth hours of the morning or afternoon may be due to the presence of a larger working force. In that case the number of accidents would necessarily be heightened.

The question has also been raised why, if fatigue is a primary cause for these accidents. their number is not greatest during the last hour of the morning and of the afternoon? If it is the workers' exhaustion which inclines them to these hazards, why does it not do so most when they are presumably most fatigued?

* Senate Document No. 645, 61st Congress, Second Session, 1911. Report on Condition of Woman and Child Wage-Earners in the United States, Vol. XI, pp. 96–97. See table on p. 76.

To this objection there are several conclusive replies. In the first place, the variation in the lunch hour in different establishments lessens the number of persons at work between eleven and one o'clock.* So, also, variations in "quitting time" and the smaller number of persons at work between five and six, go toward explaining the usually smaller number of accidents which occur at that time. Moreover, some familiar psychological phenomena help further to explain the smaller number of accidents during the first and last hours of morning and afternoon employment. It is well known that the first period of work is one of "limbering up," when the worker has not yet reached his normal plane of efficiency or production. During the last hour of work, also, with increasing fatigue, the rate naturally falls. In a subsequent chapter we shall observe, from actual experiments, how markedly the productivity and output drop during the last hours of the morning and afternoon.

Now this lower rate of activity, due to complex causes, is in all probability a highly important factor in the reduced accident rate during the first and last hours of the morning and afternoon. It is well known that operations requiring increased speed tend to produce a heightened accident rate, and the reverse is as true. With the slackening of speed and production, therefore, it is natural for the accident rate to fall. Thus the effects of fatigue upon the accident rate are both direct and indirect. As the American report acutely says:†

"It is evident that in the interrelation of influences acting upon the situation now one and now another may be dominant. The most constant factor will be fatigue. It will be present in varying proportion in every case. It may act with the tendency to increase speed to produce

* "In one Chicago plant employing about 3,000 men and women, the writer found that practically one-half of this number took their lunch from 11:30 to 12. Frequently the employees begin their afternoon period of work at 12:45 p. m. and in some cities at 12:30 p. m."—Bogardus, op. cit., p. 513.

† Senate Document No. 645, Vol. XI, p. 100.

a greater number of accidents. It may in the end become so pronounced that speed is reduced and the accident rate lowered. . . . It is a steadily progressive process. It gradually upsets those nice adjustments of the living organism upon which depend efficient labor and the safety of the worker. The margin of safety in modern industry is small. It is measured too frequently by fractions of an inch. Reduce the alertness and the exactness with which the body responds to the necessities of labor, and by just so much have you increased the liability that the hand will be misplaced that fraction which means mutilation."

Obviously these statistics and surmises as to the relation of fatigue to the accident rate urgently need further confirmation. They do not completely agree and need to be clarified by a really scientific examination of both the production rate and the accident rate in the same establishments. In order to clarify the influence of fatigue on the accident rate, the number of hours worked by injured persons on the days of their injuries should obviously be included in all future statistics, besides the actual hours of incidence.

Side by side with the perfection of mechanisms and safety appliances should go the study of those underlying physiological and psychological factors which so largely contribute to swell the accident rate and which may, when better studied and understood, be modified if not obliterated by the provision of periodic rests or pauses, and similar devices to check the inroads of fatigue and exhaustion.

6. RHYTHM

The strain of machine work upon the faculty of attention thus leads to the gravest consequences. Another subtly fatiguing element in machine work, which we have not yet examined, is due to its rhythm. It is apparent that the rhythm of any power-driven machinery is fixed and mechanical, depending upon its construction and its rate of speed. Now it is true also that human beings tend to work rhythmically, and when the individual's natural swing or rhythmic

tendency must be wholly subordinated to the machine's more rapid mechanical rhythm, fatigue is likely to ensue.

Rhythm in human beings is not a fanciful or theoretic notion; it is a common endowment. The human organism instinctively attunes itself to rhythm, as a dancer yields herself to her measure, without thought or even consciousness. This is a matter of everyday experience. Some persons are palpably disturbed by the sudden stopping of a clock to the ticking of which they have been accustomed. The rhythm of the tick may be missed even in sleep; its sudden cessation is sufficient to awaken one when a bedroom clock runs down at night. Everyone knows how acutely the rhythm of a train or vessel may be missed, when one first sets foot on solid earth after a long journey.

Since the beginning of time, this natural instinct for rhythm has found an outlet in dance and song.* It was the mother of the arts. It gave birth to the folksongs and folk-dances, in which primitive people expressed themselves—their loves and hates, their dreams of life and death, and their concrete activities. Not the poetry of existence only, but all the daily offices of life—spinning, weaving, sowing the grain, harvesting, and the rest—inspired song and dance, their own rhythms.

Even today innumerable survivals persist, marking our kinship with the earlier children of men. Sailors and other workmen almost unconsciously chant or "hoy-ho" as they haul. In the midst of discordant city traffic, workmen who are mending the pavements drive steel wedges with rhythmic shouts and rhythmic alternating blows of their sledges. They know, instinctively, that the rhythm makes the work easier. So, too, soldiers march better and with less exertion to a tune. It is not only the emotional excitement of a martial air, it is the rhythmic beat of the music that helps to swing the march along in unison.

* Bücher, Karl: Arbeit und Rhythmus. Fourth edition. Leipzig, Teubner, 1909.

"For the world was built in order
And the atoms march in tune;
Rhyme the pipe, and Time the warder,
The sun obeys them and the moon. . . .
None so backward in the troop,
When the music and the dance
Reach his place and circumstance."

Even in the animal world, rhythm is natural. The rhythm of the trotting horse or the ambling camel is as individual to itself as the beat of the blacksmith's, the cobbler's or the carpenter's hammer, or the swing of the housemaid's broom. With a musical people, such as the American Negro, not only rhythmic movements but rhythmic songs persist among such diverse workers as cotton-pickers in Georgia, laborers laying railroad and trolley rails in Kentucky, and the roustabouts on the Mississippi.*

The reason why rhythm makes work easier as well as more enjoyable is that in any given tempo, each effort is followed by a corresponding rest. There is a perfect balance of swing and recovery, rise and fall, exertion and repose—"primal chimes" as Emerson, the lover of rhythm, calls them:

"Primal chimes of sun and shade,
Of sound and echo, man and maid; . . .
For Nature beats in perfect tune,
And rounds with rhyme her every rune."

If such a balance could be permanently established in work, fatigue could never occur. Such a condition exists in the physiological rhythm of the heart and respiratory muscles, which function unceasingly through life, alternating work and rest, work and rest. In its steady rhythmic tempo the heart relaxes at each contraction, exerting energy estimated at about 20,000 kilogrammeters in one day.†

Thus are we physiologically attuned to rhythm. It is our common heritage. The injury of highly speeded machine work lies, as we have said, in this, that the mechanical, rapid

* Bücher, op. cit., pp. 235–251.

† Roth, Dr. Emil: Ermüdung durch Berufsarbeit. Op. cit., p. 606. Kilogrammeter=7.2 foot pounds. For definition of foot pound see p. 195.

rhythm of machinery dominates the human agent, whatever be his natural rate or rhythmic tendency. The machine sets the tempo; the worker must keep to it.

Not only is the beat of the machine much more rapid and regular than the more elastic human rhythms; it is often wholly lost in the chaos of different rhythms of the various machines, belts, and pulleys in one workroom. The roar and vibration of machinery tends further to distract any sense of rhythm on the part of the workers.

7. PIECE-WORK

Another enemy of the physiological tempo lies in the abuse of the piece-work system. Here we must preface our physiological objections to the abuse of a system, by realizing the inherent value of the system itself, properly managed. Briefly, piece-work presupposes a naturally varying rate of work and output among individuals, according to which each worker is paid. Obviously, this should be the most just way to allow for the play of natural talents. Increased effort or skill brings its immediate reward, and the best worker is the best paid. In highly organized trades, where the piece-work system has been minutely worked out, as in the great shoe industry, neither workers nor employers would for a moment consider returning to a time basis, where individuals are paid alike by the hour.

In criticising the piece-rates, therefore, we are dealing with an entrenched practice, and criticism must attack not the system, but its flagrant abuses. These, unfortunately, are common and widespread, especially among workingwomen in poorly organized trades, where no collective bargaining protects individuals from pressure. In such occupations, of which the ramified needle and clothing trades are the best examples, piece-work develops chiefly into a system of "speeding up" the workers in both machine and hand work. The workers are spurred to a feverish intensity. They apply themselves hectically. It is almost inevitable that the most

rapid workers should be so-called "pace-makers" and set the rhythm for all the other workers. For pay is usually adjusted to the rate of the quickest workers, and in order to earn a fair wage, all the others must keep up as near to them as possible. Thus, if a quick girl can stitch ten dozen pieces of white underwear in a day, she can earn $1.50 at the rate of 15 cents per dozen. Another girl can at her natural pace stitch no more than six dozen in one day. But since she would earn only 90 cents a day at the same rate of pay, she drives herself feverishly to greater exertion. Piece-work, then, means working watch in hand. When every minute means loss of an already meager wage, the incentive to spurt is irresistible.

Many employers contend that unless workers have such incentives, or a personal stake in working steadily, they tend to slacken and are indifferent to the amount of their output so long as wages are assured. The workers, on the other hand, return that in piece-work, even the utmost speed does not assure them of their wages, since the piece-work price is often cut when the rapid workers are thought to be earning too much in one day. The rate per piece is lowered. Then the same speed is required to earn the lower wage.*

Another hardship in piece-work of which the workers justly complain and which adds greatly to the nervous tax of any occupation is due to the extraordinarily rapid changes of fashion. Thus, for example, just when a girl has become proficient enough to earn a fair wage at piece-rates in tucking women's shirtwaists, the tucks go out of fashion, and a new kind of stitching is required. Even the skilled worker is a novice at first, and cannot for some time equal the speed she had acquired by practice at her former work. Yet the manufacturer, in fixing piece-rates, rarely makes allowance for such sudden freaks of fashion, and the hardship of the inevitable changes falls on the one least able to support it, the worker.

* For a striking example of the abuse of the piece-work system in the manufacture of electric lamp bulbs, see Report on Condition of Woman and Child Wage-Earners in the United States, Vol. III, p. 480. Senate Document No. 645, 61st Congress, 2nd Session, 1911.

Her wage practically is cut and her work intensified by every shift of fashion.

Thus, though the piece-work system is sound in theory and works admirably in highly organized trades where collective agreements assure the workers fair, fixed rates, it fails among the most helpless workers who most need to be protected from over-pressure and the inroads of fatigue. With them it almost inevitably breeds a spirit of permanent "rush" in work, and to that extent it is physiologically dangerous: "the most pernicious thing that could be devised to weaken what, for a better term, might be described as the dynamic efficiency of the nervous system,"* writes a physician familiar with the effects of unregulated piece-rates among garment workers.

8. OVERTIME

The factors which we selected as typical of the new strain in industry are all aggravated and intensified by the system of overtime evening work, to which we have already made passing reference. Overtime means that after the regular day's work is done, evening work is required in addition.

Overtime is an elastic term. In its extremest forms, reported in printing and binding establishments, it lengthens the workday to twenty-four hours in one stretch. In less extreme degree, overtime is worked during the fall months until eight or nine or ten o'clock each evening in factories which supply the Christmas market; in paper box making; in the manufacture of innumerable articles of women's wear—from lace collars to Japanese kimonos; in leather and jewelry work; in making the cheaper and more lasting candies, and in many other occupations.

Indeed, overtime is common to almost all industries and

* Schwab, Dr. Sidney I. (Professor of Nervous and Mental Diseases, St. Louis University): Neurasthenia among Garment Workers. *American Labor Legislation Review*, Vol. I, No. I, p. 27. (January, 1911.)

is prevalent in every industrial center, to a degree wholly unknown to most persons. No more arresting fact emerges from the comprehensive study of wage-earning women and children made by the federal government, than the almost incredible length and duration of this form of extra employment.

People speak habitually, and labor statistics usually treat of, the so-called "normal" hours of labor, dismissing overtime as an insignificant and merely occasional side issue. Overtime is regarded as a sort of temporary emergency, similar to many other of life's stresses which people weather without permanent injury, thanks to their reserve strength. But, in fact, overtime is an integral part of the workers' lives, persisting not only for days at a time but for weeks and months; not occasionally lengthening the day's work, but during a large part of the year straining health and endurance to the utmost.

Thus, in the recent federal investigation of wage-earning women and children, agents of the government reported the normal hours of work, in miscellaneous manufactures, as 55½ in New York, 56.4 in Chicago, 53.3 in Philadelphia, 53 in Baltimore. But the average duration of overtime of selected workers in those cities, during 1907–08, was 17.3 weeks or over four months in New York, 13½ weeks or more than three months in Chicago, 16.6 weeks or again over four months in Philadelphia, 13 weeks in Baltimore.* In one printing establishment in New York City, girls were employed once and sometimes twice a week, during a period of sixteen to twenty-six weeks, for 16¾, 20¼, 22½, and 24¼ continuous hours.†

These longest *days* of overtime work are reported in New York binderies. But in a special investigation of Chicago box factories the *weeks* of overtime persisted longest.‡

* Report on Condition of Woman and Child Wage-Earners in the United States, Vol. V, pp. 204, 208, 211, 213. Senate Document No. 645. 61st Congress, 2nd Session. 1910.

† Ibid., p. 205.

‡ Bulletin of the U. S. Bureau of Labor No. 91, Nov., 1910. Working Hours of Wage-earning Women in Chicago, pp. 875–880.

Eleven box factories employing 1010 workers were investigated. Their average duration of overtime was fifteen weeks in the year; one factory reported overtime extending over thirty-seven weeks in the year; that is, more than *nine months*.* In this case, the so-called "normal" hours were worked only three months; the supposedly extra "overtime hours" were worked regularly more than nine months in the year,—a *reductio ad absurdum* of the whole matter. Yet this is not merely an eccentricity of nomenclature. It is a trick of psychology; a not unfair example of our habitual mental attitude towards the custom of overtime, accepting the shorter hours as normal and habitual, dismissing from mind the excessive hours no matter how long they may persist, as exceptional, under the head of "overtime."

Obviously, when overtime extends over such hours as those quoted here, it shares all the dangers inherent in regular night work. Upon these dangers we shall dwell subsequently, in discussing more fully the phenomenon of all night work. Here it suffices to draw attention to the fact that beside the dangers to health, there are inevitably moral dangers also, potential in all employment of women after dark.

The return home at late night or early morning hours is fraught with the peril of insult if not of attack; association with men employes at night, and during the midnight recess in establishments running all night long, presents special temptation; women who live away from home cannot easily return to reputable living places late at night.

Such hardships are incurred by the worker kept for overtime as well as by the all night worker. But physiologically considered, overtime sins against health in a way peculiar to itself. It means that the elements which make up industrial stress—speed, complexity, monotony, and the

* In this firm, the normal hours were fifty-nine in one week, the "long day" being ten hours; in the busy season (thirty-seven weeks) the "long day" was thirteen and one-half hours, and the week was made up as follows: "One nine-hour day, three thirteen and one-half-hour days and two ten-hour days, making the total number of hours for the six-day week sixty-nine and one-half." Op. cit., p. 877.

rest—must be endured by an organism which has presumably already reached its limits.

The essential injury of overtime is due to what we have seen graphically proved with the ergograph: that effort increases with fatigue; that work continued after fatigue has set in requires so much more subsequent time for recuperation. But during a "rush" or overtime season such time for recuperation is necessarily lacking. The girl who is kept in the great department stores until ten or eleven or twelve o'clock at night during one or two frenzied weeks before the holiday which heralds the reign of Peace; the girl who works at fever heat all evening stitching women's shirtwaists in January for the spring trade, is not relieved from the necessity of reporting for work at seven or eight o'clock the next morning. She comes to work unrepaired, and with each day of overtime, accumulated fatigue necessarily grows.

One of the least known and most straining forms of overtime, for which Christmas is responsible, occurs in the auditing department of the great stores. One of the largest establishments in New York City, typical of the best stores, closes its doors to shoppers throughout the winter at six o'clock. But the girls who serve behind the counters may leave every night at their regular hour though girls upstairs in the clerical department are kept until nine o'clock in the evening during more than two months, that is, from December 1 until February. They usually receive no extra pay for the three extra daily hours of work, but have an allowance of 35 cents each evening for supper money.

In theory, the requirement of overtime is supposed to be balanced by the slack period which often follows. A short period of over-exertion is assumed to be compensated by a subsequent let-up. But the slack period which often follows overtime does not give the supposed opportunity for leisure and recuperation. It is itself a season of deprivation. For slack work means slack pay, with a consequent loss rather than gain in opportunities for recuperation.

But deeper than this objection to the alternation of

overwork and idleness, is the physiological objection. During overtime, leisure and rest are cut down at the very same time that heavier and longer demands are made upon the human organism. It is practically inevitable that the metabolic balance should be thrown out of gear. Regular seasonal overtime in such occupations as those cited above, leaves the worker with too great a physiological deficit. There is no rebound, or an infinitely slow one when our elastic capacities have been too tensely stretched. It takes much more time, rest, repair than the working girl can possibly afford to make good such metabolic losses. Compensation —off-time—comes too late. As we know instinctively, and as we have seen diagrammatically proved in the laboratory, the essential thing in rest is the *time at which it comes*. Rest postponed is rest more-than-proportionally deprived of virtue. Fatigue let run is a debt to be paid at compound interest. Maggiora showed that after a doubled task, muscle requires not double but four times as long a rest for recuperation, and a similar need for more-than-proportionally increased rest after excessive work is true also of our other tissues, and of our organism in its totality.

No one need therefore be surprised to learn that after a period of overtime work, a marked growth of many minor ailments has been found where there has been medical examination of working girls and women. A recent report of the British Chief Inspector of Factories quotes a striking example of this.* In six large tobacco factories, physicians appointed by the firms reported an increase of from one-third to one-half in the number of workers coming to them for treatment after continuous overtime work. No special diseases were found but, as might be expected, aggravated cases of the ordinary ailments, such as indigestion, anæmia heavy colds in winter, gastric disorders in summer. This was in a trade considered not in itself unhealthy by the physicians quoted, and where overtime was limited by the

* British Sessional Papers, Vol. X, Appendix II, 1907, pp. 253–254.

British law so that the total amount of work done could not exceed ten and one-half hours in one day.

This is only one example of many which might be quoted. Year after year the British factory inspectors have registered their disapproval of overtime on physical grounds, and have denounced its physical effects. "Nothing short of a public scandal," "inexcusable," "outrageous," are some of the epithets repeatedly used. In France, the "veillée" or evening overtime work, especially in dressmaking establishments, comes in for the same denunciation. A German physician, Dr. Emil Roth, of Potsdam, expresses himself similarly in an address which combines scientific thoroughness with a first hand knowledge of industry. His observation inclines him to believe that the strain of seasonal overwork upon the health of working women in stores and factories is *never* compensated, but encroaches steadily upon the worker's total health and endurance, permanently lowering their levels.*

* Roth, Dr. Emil: Ermüdung durch Berufsarbeit. Op. cit., p. 610.

IV

SOME SPECIFIC STUDIES OF PHYSICAL OVER-STRAIN IN INDUSTRY

THUS a rapid glance at some actual conditions in diverse occupations such as the telephone service, the great woman-employing needle and textile and shoe trades, and the canneries, throws some light upon the new strain of industry. In all these occupations work has increased its demands upon human energies. We turn next to learn some of the physical effects upon the workers, so far as these have been observed and recorded.

As concerns the past, we have abundant testimony on the fruits of overwork, not only regarding those who have themselves been bound to exacting tasks, but regarding their children and the communities in which their lives were spent. This kind of testimony, to which we shall often have occasion to refer in this study, is found in the accumulated official and unofficial reports of the inspectors and physicians who have had daily to observe the conditions of labor at first hand, and whose unconscious unanimity gives to their evidence, as we have pointed out, a strangely heightened power. The individual observer may exaggerate or minimize or strain the facts. But no one can read without a deep sense of its total truth, the reiterated evidence of generations of such observers, in many countries, writing independently but agreeing fundamentally in their observations and diagnoses.*

There is a peculiar significance in this kind of testimony. It is the accumulated experience of mankind and has an authority due to its very iterations. This is the power and

* See Part II of this volume.

the moving appeal of history, that it gives us, as fiction rarely can, precisely the cumulative experiences, the persistent realities of our common lot. A truth that has been a hundred years in the forging is, in so far forth, just so much the truer. It is not a mathematical formula, proved once for all and immutable. The truths of history gain in meaning and power under changed guises, coming down to the children of a later age with a fuller and more significant content. This is as true of industrial history as of any other; and hence the industrial experience of the past should enable us more intelligently to estimate our own difficulties and performances.

1. INFANT MORTALITY

According to the testimony of many observers, the industrial overstrain of women has commonly reacted in three visible ways: in a heightened infant mortality, a lowered birth rate, and an impaired second generation. We can readily see that many factors besides overwork contribute to the greater mortality of infants among the working class. Probably improper feeding holds the first place amongst causes, and overcrowding, with all its train of ills such as foul air, dirt, and darkness, is an important item. But the relation, direct and indirect, between women's industrial work and a high death rate among infants is well-established. Few exact and detailed studies of this relationship have been made in our country, but it has been pointed out that infant mortality is highest in industrial communities where mainly women are employed in factories. Thus an abnormally high death rate of infants is asserted to exist in two cotton mill towns of New England,—Fall River, Massachusetts, and Biddeford, Maine.*

The latest government statistics also show the abnormally high infant mortality in textile towns. In 1910, in selected

* Prevention of Infant Mortality. Being the papers and discussions of a Conference on Prevention of Infant Mortality, New Haven, Conn., 1909, p. 37. Under the Auspices of the American Academy of Medicine.

cities, the number of deaths of infants under one year, per 100 deaths at all ages, was as follows:*

Boston	19
Chicago	21
New York City	21
Biddeford	27
Lowell	29
Lawrence	35
Holyoke	35
Fall River	39

In 1910 the number of deaths of infants under one year, per 1000 births, in selected cities was as follows:†

New York City	125
Boston	126
Philadelphia	138
Lawrence	167
New Bedford	177
Holyoke	213
Lowell	231

More detailed studies abroad have sought to show the relation between a high mortality of young children and the industrial employment of women. The death rate of infants is said to increase in proportion to the increase in the number of women at work. Dr. Newman in his standard work‡ devotes material attention to this subject as it affects the death rate in Great Britain. He compares eight towns chosen for their low percentage of women at work and eight towns chosen for their high percentage of women engaged in the textile trades, between the ages of fifteen and thirty-five years, that is, during the ages of reproductive potentiality.

In the non-textile towns, the average yearly infant mortality during the decennium, 1896 to 1905, was 150 per 1,000 infants.

* Bureau of the Census. Department of Commerce and Labor. Bulletin 109. Mortality Statistics, 1910, p. 14. Washington, 1912.

† Ibid., p. 18.

‡ Newman, George, M.D. (Lecturer on Public Health at St. Bartholomew's Hospital, London; Medical Officer of Health of Metropolitan Borough of Finsbury): Infant Mortality, p. 105. New York, E. P. Dutton and Co., 1907.

AVERAGE INFANT MORTALITY RATE IN SOME ENGLISH NON-TEXTILE TOWNS, 1896–1905

Town	*Infant Mortality Rate, 1896–1905*	Percentage of Occupied Women, ages 15 to 35	
		Total	*Married or Widowed*
Sunderland	166	55.1	2.8
Swansen	160	59.4	5.0
Lincoln	157	63.3	3.2
South Shields	155	53.8	3.0
Newton	153	63.6	2.6
Cardiff	147	62.6	3.8
Barrow-in-Furness	144	57.9	2.9
Burton	119	60.5	2.0
Average	150	59.5	3.1

In the textile towns, on the other hand, the average infant mortality was 182 per 1,000 infants, rising as high as 208.*

INFANT MORTALITY RATE IN SOME ENGLISH TEXTILE TOWNS, 1896–1905

Town	*Infant Mortality Rate, 1896–1905*	Percentage of Occupied Women, ages 15 to 35	
		Total	*Married or Widowed*
Burnley	208	90.9	59.7
Preston	208	84.4	50.5
Blackburn	183	91.8	63.9
Nottingham	180	84.6	27.5
Leicester	175	87.6	41.6
Oldham	170	87.3	33.4
Bolton	166	87.4	24.7
Bury	164	88.9	44.8
Average	182	88.4	43.2

* Newman, op. cit., p. 106.

From these tables it appears that the percentage of workingwomen between fifteen and thirty-five years in the high mortality textile towns was 28.9 per cent higher than in the low mortality towns; the percentage of married workingwomen was 40 per cent more than in the low mortality towns.

Another careful study extending over twenty years was made by the medical officer of health of Kearsley, a Lancashire town of about 10,000 inhabitants. The death rate of Kearsley remained stationary between 1885 and 1904, but the infant death rate rose in the same period from 143 to 229. During the same period the birth rate fell from 39 to 27 per 1,000. These striking figures are attributed to the fact that the town has developed into a manufacturing district of many mills, where large numbers of women are employed.

Again, in Preston, the increase in infant mortality was so marked between 1881 and 1900 that a committee was appointed to study the matter. While the general death rate sank from 24.73 to 20.80, the number of babies who died rose from 208 to 236 per 1,000 infants. The committee reported* that in its opinion the causes of this increase were the employment of women in mills and the consequent enforced neglect of babies at home.

Dr. Newman sums up the whole matter by saying:†

"It is the employment of women from girlhood all through married life, and through the period of child-bearing —the continual stress and strain of the work and hours and general conditions prevailing in women's labour—that is exerting its baneful influence on the individual and on the home."

If the death rate of infants is so high where women are employed in the protected British textile trade, with its ten-hour day and fifty-five and a half hour week en-

* Report on Health of Preston, 1902, pp. 10–12. (Quoted by Newman, p. 136.)

† Newman, *op. cit.*, p. 136.

forced, we may well ask what are likely to be the effects of the stress and strain of such American industries as we have examined above, upon child bearing and infant mortality.

2. LOW BIRTH RATE

It is true that women's industrial work probably affects the infant death rate less here than abroad owing to the far smaller proportion of married women in industry. But a point of equal importance is the effect of industrial overstrain in lowering the birth rate itself. It is not only the work of women after marriage, or just before confinement, which most gravely affects childbirth. The pressure of industry has not only in innumerable cases marred, but often destroyed altogether that immemorial function of women, the center of the tenderest associations of our race. Medical authorities assert that the strain of continuous standing and overwork during girlhood, such as many young women endure in stores as well as factories, is responsible for unmistakable pelvic and uterine disease and sometimes subsequent sterility after marriage.

The most impressive evidence on this topic was brought out in England, in successive efforts to establish by law a shorter workday in mercantile establishments. The reports of select committees (several of which sat between 1886 and 1901 and heard the highest medical testimony regarding the effects of work in stores), dwell insistently upon the injuries from the long hours and the continuous standing upon the generative organs, in girlhood as well as after marriage.

From among a large number of medical statements we may cite one by Dr. Grigg, out-patient physician for the diseases of women at Westminster Hospital, senior physician to the Queen Charlotte Lying-in Hospital, and connected with the Victoria Hospital for children. This physician was questioned about the injuries of overwork to the health of girls and women employed in stores, "shop-girl assistants"

as they are called in England. He said of the prolonged hours:*

"They have a very grave effect upon the generative organs of women, entailing a great deal of suffering, and also injuring a very large body of them permanently, setting up inflammation in the pelvis in connection with these organs.

"If the matter could be gone into carefully, I think the Committee would be perfectly surprised to find what a large number of these women are rendered sterile in consequence of these prolonged hours.

"I think it must be acknowledged sterility is often due to this inflammatory mischief arising around the generative organs. I believe that it is one of the greatest evils attached to these prolonged hours. I have seen many cases in families where certain members who have pursued the calling of shop-girl assistants have been sterile, while other members of the family have borne children. I know of one case where four members of a family who were shop girls were sterile and two other girls, not shop girls, have borne children; and I have known other cases in which this has occurred. . . . I have patients come to me from all parts of London. It appears to be a most common condition."

Not only do the children of mothers at work or overstrained during girlhood die in greater numbers, but the birth rate is lower. The most detailed studies on this subject appear to have been made by Professor Ugo Broggi, who has published extensive figures on the fecundity of working women. He states† that of 172,365 Italian working women between the ages of fifteen and fifty-four, who were employed in industrial occupations, the average child-bearing co-efficient was only 45 per thousand or about one-third of the general fertility of Italian women (120 per thousand).

* British Sessional Papers, Vol. XII, 1895. Report of Select Committee on Shops (Early Closing Bill), pp. 219–220. Witness, Dr. W. Chapman Grigg.

See also Part II of this volume, pp. 135–142.

† Zeitschrift der Socialen Wissenschaft, Bd. VIII, Nr. 10, 1905. Die Fruchtbarkeit der selbstarbeitenden und den arbeitenden Ständen angehörigen Frauen, p. 663.

3. RACE DEGENERATION

Besides a high death rate and a low birth rate, subnormalities of size and weight often characterize the children born of working mothers. Thus are they handicapped at the start and the misfortunes of the parents are visited upon the next generation.

Such racial deterioration, due to the extremest overwork, was unmistakably evident in England after the first period of unchecked industrial exploitation. Between 1830 and 1840 the intolerable overwork of two generations achieved its result. The accounts of eye-witnesses, horrified by the appearance of the factory population, agree that there was a visible decline in the stature and strength as well as in the morals of the manufacturing shires.

"The factory population appear to have become a distinct race, that was known at a glance, so defined had the effects of overwork and unhealthy dwellings become upon the physical appearance and condition of the people."*

"Competition far from regulation had in half a century produced a race of pale, stunted, and emaciated creatures, irregular in their lives and dissolute in their habits. Their case appeared so desperate that for those who believed in *laissez faire*, 'the only hope,' as Harriet Martineau confessed, 'seems to be that the race will die out in two or three generations.'"†

Home life was totally lost; young children, girls, and women were all pressed into the service; the very preservation of the race was threatened.

In more recent times, the existence of racial deterioration, due in large part to overwork and exhaustion, has been interestingly corroborated by the statistics of military service. In various countries, especially where such service is compulsory, it has been found that the proportion of young

* British Sessional Papers, 1875, Vol. XVI, p. 23.
See also Part II of this volume, pp. 276–286.

† The Case for the Factory Acts. Edited by Mrs. Sidney Webb. p. 46. London, Grant Richards, 1901.

men rejected for physical unfitness is far higher in industrial communities than in others.

The great physiologist Mosso drew attention to this fact regarding the exploited *carusi* or sulphur workers of Sicily. He had been sent to the island as a young army surgeon, and he first realized there, with a shock of horror, the "ruin which the exhaustion of fatigue brings about in man" when he saw the evidences of his countrymen's degeneration in the province of Caltanisetta, in the midst of the loveliest natural scenery in the world. Such was the physical condition of these people that in the four years between 1881 and 1884, out of 3,672 sulphur workers who presented themselves at the recruiting offices, only 203 were declared fit for service.*

At about the same time, in 1886, Dr. Schuler, the eminent Swiss factory inspector, reported† to a congress of German scientists and physicians at Strassburg, that the factory work of young persons in Switzerland was attracting marked attention owing to the shocking statistics of recruiting offices. Dr. Schuler stated that in rural districts, where there were few mills, only 14.3 per cent to 18.9 per cent of the recruits were found unfit for immediate service and were temporarily rejected (that is, had their terms of service postponed for two years). In factory districts, 19.7 to 23.3 per cent of the young men were found unfit for service and were temporarily rejected. It had been assumed that the higher standard of living obtained through the increased wages of factory workers would compensate for the hardships of factory life. But these expectations were not fulfilled. Later investigations showed that in the canton of Zug, for instance, only 37 per cent of cotton mill operatives were physically fit for service, while in the same canton among farm laborers 49 per cent were fit, and among artisans from 47

* Mosso, op. cit. English translation, pp. 158–159.

† Deutsche Vierteljahresschrift für öffentliche Gesundheitspflege, Vol. XVIII, 1880, pp. 134–135. 58. Kongress der Deutschen Naturforscher und Ärzte. Schuler, Dr. F.: Die Überbürdung der Arbeiterinnen und Kinder in Fabriken.

to 83 per cent were fit. In another canton, Thurgau, 34 to 39 per cent of factory workers were rejected as against 12 to 23 per cent of non-factory workers.

A more recent study of German workingmen gives similar figures. It is stated by a German physician,* on the authority of a local magistrate who had long been studying the subject, that in a district where the manufacturing of nails had long been carried on, only 26 per cent of the workers liable for military service had been found physically fit. In another district, where buckles were extensively manufactured, only 21 per cent of the young men were fit. These very unfavorable figures are said to be due to long hours and great monotony of work requiring the constant repetition of mechanical movements. "The avoidance of such dangers to the future defense of the country," says Dr. Ascher, "lies in shorter hours of work, and exercise as a preventive of some of these physical defects."

The report of the French factory inspectors in 1900 on the question of night work also dwells upon the physical deterioration observed at the recruiting offices. They state that in industrial centers the proportion of rejections on account of physical unfitness has been as high as 50 per cent while in the country it is only about 25 per cent.†

Doubtless many incidents of city life such as overcrowding and unsanitary housing help to swell the numbers of

* Handbuch der Arbeiterwohlfahrt. Edited by Dr. Otto Dammer. Bd. I. Ascher, Dr.: Beschädigungen der Arbeiter bei der Arbeit, p. 494. Stuttgart, Enke, 1902.

† Rapports présentés à M. le Ministre de Commerce, de l'Industrie, des Postes et des Télégraphes, par les Inspecteurs du Travail. La Question de l'Interdiction du Travail de Nuit, p. 73. Paris, Imprimerie Nationale, 1900.

See also, Report of the Eighth International Congress of Hygiene and Demography, Vol. VII, Section VII, Budapest, 1894. Donath, Dr. Julius (Univ. of Budapest): Der Physische Rückgang der Bevölkerung in den Modernen Culturstaaten, mit besonderer Rücksicht auf Oesterreich-Ungarn.

Tenth International Congress of Hygiene and Demography, Paris, 1900. Vaillant, M. Edouard, (M. R. C. S. England): Législation et Réglementation du Travail au point de Vue de l'Hygiène.

British Sessional Papers, 1904, Vol. XXXII. Report of the Inter-Departmental Committee on Physical Deterioration, Vols. I, II, and III.

almost $120,000,000 have been invested in workmen's dwellings, hospitals and convalescent houses, sanitaria, baths, and similar institutions of welfare."

The sanitaria of the German State Insurance Department were founded for the treatment of insured working people who have fallen ill. Obviously, to cure the sick and restore their working capacity is more economical as well as more humane than to continue merely to pay out insurance. Accordingly, in 1889, a law was passed authorizing insurance societies to invest part of their funds in hospitals and sanitaria, to afford the best facilities for speedy recovery, and as far as possible to prevent permanent disabilities.* The first sanitarium was built in 1894 at Gütergutz for about 100 chronic male cases. Applications for treatment were so numerous that a larger sanitarium for both men and women was next erected at Beelitz, near Berlin.

Aside from the direct benefit to working people from the immediate diagnoses of their illnesses and the treatment received, the establishment of the sanitaria has been of incalculable value in stimulating a new interest in the underlying causes of illness. Hundreds of working people were gathered together for treatment. Many were found suffering from the same disorders; some diseases were found

*"Of special interest is the item of medical care. In the five years between 1900–1905 the cost of treatment rose from 5,578,300 marks ($1,394,575) to 12,158,800 marks ($3,039,700) and in 1907 the figure reached 15,186,300 marks ($3,796,575). This is one of the most admirable outgrowths of the pension system. To avoid having an unnecessarily large number of chronic invalids to support, the insurance system has developed a great preventive and restorative movement. . . .

"Thousands of cases are treated each year and a large percentage of those who ordinarily would have become permanent public charges are either fully restored to strength, or at any rate enabled to do something towards their own support. There is at present great enthusiasm for this system, and the ailing are only too eager to take advantage of the opportunities offered them, as it puts at their disposal medical treatment, rest, food, shelter, clothing, sanitary surroundings and care which otherwise would be far beyond their means." Frankel, Lee K., and Dawson, Miles W.: Workingmen's Insurance in Europe, p. 356. Russell Sage Foundation Publication. New York, Charities Publication Committee, 1910.

See also Kober, Dr. Geo. M.: Industrial and Personal Hygiene, p. 90. Published by the President's Homes Commission, Washington, D. C., 1908.

increasing at abnormally rapid rates. Here were facts, for the first time not only accessible, but challenging the curiosity of physicians. Might the causes for such common ills lurk unrecognized in the workers' previous lives? The physicians were indeed forced to conclude that some common factors in the lives of workingmen and women must be responsible for the spread of certain diseases. What were such common factors? The question widens from the purely medical to something social and economic. Prevention is becoming each year a more insistent demand, and in the interests of prevention the nature of the worker's occupation, at which more than half of his waking life is spent, has received a new medical attention.

6. THE INCREASE OF NERVOUS DISORDERS

Now it is of unusual interest for our special inquiry, to find that these most common diseases of patients in the German insurance sanitaria (not including tuberculosis) were found to be precisely the nervous disorders springing from industrial strain and overpressure.

In a thoughtful article, two physicians formerly of the Beelitz Sanitarium write:*

"The increase of diseases of the nervous system among working people in the last decade is a fact that is now firmly established by extensive and carefully conducted statistical inquiry. This is most clearly evident in respect to the psychoses; but there is also no doubt, in the minds of the most informed authorities, that neurasthenia—which, though less menacing than insanity to the efficiency and labor capacity of the worker is still sufficiently serious in this respect—is also steadily increasing in frequency and in severity. . . . Though, for some years, not only the laity, but also the chief medical experts on neurasthenia, as Löwenfeld and Binswanger, overlooked the working classes in relation to this disease, this attitude is now radically changed. On all sides,

* Deutsche Medizinische Wochenschrift, 25. May, 1905, p. 820. Dr. P. Leubuscher u. Dr. W. Bibrowicz: Die Neurasthenie in Arbeiterkreisen.

in the clinics and physicians' offices, and by the managers of the large insurance funds, proofs of the enormous increase of neurasthenia as a cause of inability to work are being presented."

In a recent report, the physician-in-chief of the Beelitz Sanitarium says:*

"In the course of the year, 1815 men and 803 women were treated. . . .

"Of the 1815 male patients who were discharged, 1206, in round numbers almost 70 per cent, were nervous cases. While in some the exciting cause of the breakdown might be variously explained, in by far the largest proportion of it arose from overstrain of their daily labor.

"Of the female cases, more than one-seventh, or 128 of 803, were anæmic and chlorotic. Among these, one-half of all suffered from nerve strain although other complications might be present."

The serious effects upon working capacity of these nervous disorders, in comparison with other diseases, may be seen in the following figures, giving the entire number of days lost from work on account of sickness.†

COMPARATIVE NUMBER OF WORKING DAYS LOST BY PATIENTS AT BEELITZ SANITARIUM.—BY DISEASE GROUPS

Disease Groups	*Total number of working days lost from time of cessation of work to time of discharge from Sanitarium*	
	Men	*Women*
Infections	60	373
Poisonings	1,259	..
Malnutritions	2,773	7,861
Skin, Muscles, Joints, etc.	5,177	935
Nervous Disorders	44,965	25,075

Dr. Lübenau, assistant physician at Beelitz, writes in

* Verwaltungsbericht der Landesversicherungsanstalt Berlin für das Jahr 1909, p. 112. Similar statistics may be found in the reports of preceding years.

† Entire table not reproduced.

an article on "Heart Disease among the Working People of Berlin":*

"In coming to the class of cardiac neuroses it is to be remarked that nervous affections of the heart among Berlin workmen are very common, as may be inferred from the extraordinary prevalence of neurasthenia. . . . In most of these cases of simple neurasthenia, nervous affections of the heart are the rule. There is the sensation of palpitations, pain in the region of the heart, a feeling of great anxiety, and shortness of breath after exertion. Such diseases have serious importance for workers on account of cardiac complication.

"The cases described above are limited to those in which the heart symptoms of nervous origin present the dominating features and which, therefore, may be regarded purely as cases of cardiac neuroses."

Another physician, Dr. Emil Roth of Potsdam, who has been prominent in the study of diseases of working people, says:†

"How alarming the increase of anæmia and neurasthenia among working people has been in the past ten years is shown by the records of the sick benefit funds, the polyclinics, and the hospitals. Many medical and scientific authorities have emphasized the increase of neurasthenia in the working classes. The ample materials of the Berlin State Insurance Sanitarium at Beelitz have more particularly served to prove the steady increase of neurasthenia,—actually from 18 per cent in 1897 to 40 per cent in 1904. Similar figures are shown by the sanitarium at Zehlendorf, where the highest percentage of neurotic patients were handworkers and skilled workers, with whom the combination of physical and mental strain reacted destructively on the nervous system."

Doubtless such an increase in figures is due to improved diagnosis as well as to the actual growth of neurasthenia among working people. The insurance physicians have

* Zeitschrift für klinische Medizin, Bd. 60. 1906. Aus dem Sanatorium der Landesversicherungsanstalt Berlin. Über Herzerkrankungen in der Berliner Arbeiterbevölkerung, pp. 136 and 137.

† Roth, Dr. Emil: Ermüdung durch Berufsarbeit. Op. cit., pp. 613–614.

come to designate as neurasthenic, illnesses which formerly were called heart troubles, indigestion, and the like.

But whatever the exact rate of increase in nervous disorders, we are more nearly concerned in the fact of their existence today, established by the more careful, immediate diagnosis of wage-earners by the insurance physicians. The liability of working people to nervous disorders from overstrain is still so little recognized that these physicians feel constrained to state specifically that they find no differences, as to clinical appearances, between the neurasthenic workman and the neurasthenic patient of any other social class. The symptoms and conditions are the same.

They are no less assured that the nervous breakdown of these workers is to be ascribed in large part to the industrial overpressure to which they are subjected. Thus a recent authoritative American study of foreign insurance systems reports:*

"The authorities insist, that increase of sickness is genuine and is due in Germany to the stress and strain of modern industry. Hours of labor are from eight to fifteen per day. The large stores, for instance, open at 8 a. m. and close at 8 p. m., allowing one hour for luncheon. It has been ascertained that in those factories where the hours are longest, the greatest number of cases of accident and sickness occur. Many workmen continue to work even when really incapacitated, and only when the slack season comes do they take advantage of the opportunity to consult a physician. This, it is asserted, accounts for the increase of sickness during such periods."

Dr. Roth, quoted above, says on this point:†

"The psychic factor is also important in another respect. With the progressive division of labor, work has become more and more mechanical. . . . A definite share of overfatigue and its sequels, especially neurasthenia, must be ascribed to this monotony; to the absence of spontaneity or joy in work. . . . But that monotony is also of

* Frankel and Dawson, op. cit., p. 242.

† Roth, op. cit., pp. 611; 613–615.

importance in so far as it nullifies pleasure in work, thereby favoring the onset of fatigue, must also be admitted from a part of the statistics. So, according to a factory inspector, the effect of certain light work with corset steels, admitting of no break for several hours, was distinctly fatiguing; the remedy was a periodical change of work for the employees in question.

"Of greater importance is the excessive overstrain of piece-work, which indeed pays better, but at the cost of a speed and intensity of work which was formerly unknown. That these injurious effects first assail the weaker part of the working population is self-evident. My own observations, especially in textile mills, confirmed the frequency of anæmia and neurasthenia, especially among young women."

An observer at the Zehlendorf sanitarium writes in a similar vein:*

"It seems indubitable that factory work considerably outweighs other occupations in the sense that it provides the greatest number of factors tending to produce the neuroses of work in the industrial populations, and I am compelled to conclude that modern industry, continually developing as it is on more and more colossal lines, constitutes a dangerous and potent cause for a continuous increase of neurasthenia and hysteria."

Dr. Treves of Turin, who unites with physiological and psychological knowledge a keen insight into industrial conditions, sums up the whole question when he says:†

"Does what physicians call 'exhaustion' (surmenage) really exist in the working population? This question, which was not thought of in the earliest studies of neurasthenia, since neurasthenic conditions were supposed to be ailments of the liberal professions and those engaged in intense intellectual application exclusively, has today been answered by the medical profession in the affirmative; the daily ob-

* Schönhals, Paul: Über die Ursachen der Neurasthenie u. Hysterie bei Arbeitern, p. 26. Berlin, 1906. (A Study of 200 Cases in the Workingman's Sanitarium at Zehlendorf.)

† Fourteenth International Congress of Hygiene and Demography, Vol. II, Sec. IV, Berlin, 1907, pp. 626–627.

See also Part II of this volume, pp. 163–185.

servation of workers in hospital and dispensary has led to this conclusion. . . . Overstrain resulting from occupation does exist; it is also entirely possible to combat it; there is, in short, a problem of overwork. . . .

"This overstrain, which physiologists, psychologists, clinicians, and above all nerve specialists and alienists, encounter so often as to be no longer deceived by it, does not present a well-defined morbid picture; but it is a slow deviation, often obscured by its very slowness, and predisposing to illness of any nature; it is the borderland of illness."

It is extremely interesting to find a similar stress upon the occurrence of nervous disorders in the detailed testimony of the distinguished physicians called in by the Canadian Royal Commission, which investigated the telephone service in Toronto a few years ago. Many of them, in their practice, had treated telephone operators for eye strain, headache, and affections of the ears. But the chief emphasis in their testimony was laid, not upon such specific injuries to the special sense organs, but upon the detriment to the operator's total health, particularly to her nervous organization.

"The service is such a strain upon the sight, hearing, speech, and muscles of the arms and body, that it is nerve exhausting,"

testified one physician* of eighteen years' practice, associate professor of clinical medicine in Toronto University.

Another physician of thirty-one years' practice, testified† that he had attended employes suffering

"from nervous debility occasioned by the strain of that particular work upon the nervous system, which includes the senses of hearing, speaking, seeing, and using arms, causing too much strain upon the nerve center. . . . In a number of cases of young ladies whom I had known as the physician of the family before they entered into the tele-

* Dr. William B. Thistle. Report of the Royal Commission. Op. cit., p. 71.

† Dr. William Britton of the University of Toronto, and of the Medical Council. Ibid., pp. 66–67.

phone service and who were apparently healthy, after a length of service in the telephone office I had to prescribe for them for various types of nervous debility, and my advice to the majority of them was to discontinue the work. The constant listening and the keen buzzing means a state of tension of the nervous system all the time; fifteen minutes' relief would be a very slight one. I have quite often seen nervous hysteria from this nervous strain to the telephone girls."

The medical superintendent of the Toronto Asylum testified:*

"Work is automatic only to a limited extent. It requires a mental effort every time. Nervous strain is intense and would react on the physical health in a marked way after three years' service, and might pass on to the next generation in a more striking way than even in the present generation. I am basing that statement on my every day experiences with just such cases, having an experience on that kind of thing for several years."

The professor of therapeutics, and teacher in connection with the diseases of the eye and ear in Toronto University, stated:†

"The result of work would be nerve fag, and might be a nervous breakdown. . . . We know practically that changes in illumination from dark to light do irritate the optic nerve, and that is going on all the time. . . . Flashing of the light has an irritating effect and is in that way injurious. The nerves governing the extra ocular muscles which focus the eye upon the object looked upon, are the nerves where the greatest part of the strain comes. The sound kept up for hours must have an effect on the auditory nerves, and if for long hours, an injurious effect might cause deafness. The possibility of receiving shocks would add to the nerve strain, effect on vocal organs not much. The effect upon the nervous system is through the nerves of the eye and the auditory nerves; reaching is subsidiary; operating together causes the difficulty."

* Dr. Charles R. Clark. Ibid., p. 72.
† Dr. J. M. McCallum. Ibid., p. 72.

Similar statements were repeated by all the physicians who testified. They concluded that the only preventive was to regulate most carefully the hours of work so taxing to women's physical powers; and above all, to break the work by proper relief periods for rest and recuperation. A continuous stretch of work without rest, for even a comparatively short time, was unanimously condemned, precisely on the ground of the excessive nervous strain.

"It is the length of time, rather than the number of calls that I emphasize."

"It is the period that she is on duty with her faculties on the alert constantly that is more important than the volume of work done."

Such is the sentiment repeatedly expressed.

The only American publication on this subject known to the writer, are some notes by a St. Louis physician on the strikingly large percentage of neurasthenics found among 7,000 garment workers, during a period of ten years, at the St. Louis Jewish Dispensary.* This physician, without going further afield, limits his conclusions strictly to the "stubborn fact" observed: "that 20 to 30 per cent of these 7,000 garment workers applying for relief were found to be subjects of neurasthenia," meaning by that term the "clinical entity" understood among neurologists. He draws attention to two phases of their employment which seem to have a "very positive influence on the production of neurasthenia." These are the irregularity of employment in the garment trades and piece-work—both of them common incidents of industrial life upon whose sinister possibilities we have elsewhere dwelt.

* Schwab, Sidney I. (Professor of Nervous and Mental Diseases, St. Louis University): Neurasthenia Among Garment Workers. *American Labor Legislation Review*, Vol. I, No. I, p. 27. (January, 1911.)

7. GENERAL PREDISPOSITION TO DISEASE

The close causal connection between overfatigue and certain types of nervous disease must not obscure the much larger and more significant rôle of fatigue in undermining health, to which Professor Treves refers above as the "borderland of illness." Fatigue not only causes specific ills; its victims are predisposed to disease in general. It is today almost a truism that health and freedom from illness spring from a maximum power of resistance. Not absence of exposure but strength of resistance is what keeps us well. It is the peculiar misery of the exhausted that they fall victims to the first infection or minor ailment which they may happen to encounter. This is apparent in everyday life; and in the laboratory, animal experimentation tends to show that fatigue markedly diminishes the power of the blood to overcome bacteria and their toxic products.*

The danger of even indirectly spreading infectious diseases needs no emphasis. Work which exhausts, and so contributes to the spread of infections and epidemics, is clearly a public as well as a private menace. On this ground, the overstrain of thousands of workingmen and workingwomen which keeps a large part of our population in fit condition to take and spread contagions, should be considered as intolerable as any other provocation of epidemics.

But even careful observers are apt to underrate or ignore the predominating influence of overfatigue in causing the lowered vitality and the minor ailments of working people. Our analysis of exhaustion as due to the accumulation of fatigue products and an excessive drain on men's energies,

* Charrin and Roget: Archives de Physiologie normale et pathologique, 1890. No. 2, p. 273.

Wetzel, G.: Pflüger's Archiv, 1900. Bd. 82, p. 505.

Cohnstein, Dr. Wilhelm: Virchow's Archiv, 1892. Bd. 130, p. 332.

De Sandro, Domenico: Riforma Med., 1910, XXXV, pp. 841 and 871. Reviewed in the Journal of the American Medical Association, Vol. LVI, No. I, p. 46. (Jan. 7, 1911.)

Abbott, A. C., and Gildersleeve, N.: The Influence of Muscular Fatigue and of Alcohol on Certain of the Normal Defenses. Univ. of Penn. Medical Bul., Vol. 23, pp. 169–181. 1910.

will have been useless if it does not help us to realize anew how health hangs upon the metabolic balance; how vitality and resistance spring buoyant from physiologic equilibrium; and how fatally overstrain tips the scales down.

8. A NEW MEDICAL SCRUTINY OF OVERWORK

The physiological study of overwork must be sharply differentiated from the longer established study of special trade diseases. Medical interest in the special diseases of various trades is of long standing, and has been growing steadily since the Italian Ramazzini first drew attention to the diseases of working people over 200 years ago.* The literature of special trade illnesses—lead poisoning, phosphorous poisoning, arsenic poisoning, anthrax, diseases from lint, fluff, dust, humidity, extremes of temperature, and the like—is enormous, a recent partial bibliography in regard to tuberculosis alone filling almost twenty printed pages of close type.†

In every country where sickness insurance exists, the study of trade diseases is bound to grow steadily. Day by day and year by year many physicians attached to insurance societies have opportunities of observing and treating cases of industrial disease. Thus, for instance, in 1908 the largest sickness insurance society in Germany, the Local Society of Leipzig, employed under contract 410 physicians, 137 specialists, 23 dentists, 55 druggists, and 20 opticians.‡ Trade diseases, indeed, have become so important a branch of medical practice abroad that the establishment of special chairs at universities for the training of specialists in these branches has been advocated.§ Medical courses on simula-

* Ramazzini, B.: De Morbis Artificium Diatriba, Modena, 1701.

† Bulletin of the U. S. Bureau of Labor, No. 79, 1908. Hoffman, Frederick L.: Mortality from Consumption in Dusty Trades.

‡ Frankel and Dawson, op. cit., p. 258.

§ Congrès Internationale des Assurance Sociales. Rome, 1908, Session 8. Peyser, Dr. Alfred (Berlin): Die Soziale Medizin als Gegenstand des Unterrichts. Sternberg, Prof. Dr. Max (Vienna): Die Soziale Medizin als Besonderer Unterrichts Gegenstand.

tion, or the attempts of working people to counterfeit trade diseases, are even now regularly given by European professors. In March, 1910, the first clinic for the treatment of industrial diseases was dedicated in Milan.

But in all this, the emphasis upon fatigue and the causal connection between overwork and disease has until recently been slight. Now, for the first time, in the workmen's insurance system, the sinister rôle of overwork is beginning to show itself unmistakably. The medical observation of fatigue in industry, even abroad, is recent and still quite disorganized. There is abundant complaint that the vast opportunities of investigation among insured working people are not yet utilized; that the present methods of observation are inadequate, and that standards are lacking for diagnoses of illnesses and their industrial causes. But the essential fact is that a new medical scrutiny of modern work and its strain on human energies has at least begun. It centers on *fatigue as itself a danger of occupation.*

This new medical emphasis on industrial fatigue and overwork was conspicuous at the last meeting of the International Congress of Hygiene held at Berlin in 1907. Discussions of fatigue and exhaustion as dangers of occupation were given a new place of prominence.* Even earlier, this congress of physicians and scientists had devoted some attention to the subject at its meetings in Budapest, 1894, and in Paris, 1900. At its meeting in Brussels, 1903, the congress urged governments to study overfatigue as one of the most fertile sources of ill health among working people. This recommendation was quoted and repeated in hearings before the British Interdepartmental Committee on Physical Degeneration in 1904.

The Italians, among whom the laboratory studies of fatigue have been so extensively carried on, take a prominent part in this new research. They call it inclusively *Patalogia del Lavoro*, pathology of work, or the study of all those factors

* Ermüdung durch Berufsarbeit. Discussed by Dr. Z. Treves of Turin, Dr. E. Roth of Potsdam, and others.

in work which result in abnormal or pathologic consequences to the human organism. As Dr. Giglioli of Florence, himself one of the young Italians at work in this new field, says:*

"The first vague Ramazzinian conception of trade diseases has developed into the wider and more definite theory of the pathology of labor. This most important division of social medicine has developed in a very short time into a well organized and distinct study. It is not, nor does it tend to become, what is popularly called a 'specialty,' but it has the dignity of being considered the most modern branch of medical study, and has its ardent expounders, clinics, laboratories, and students.

"It is a very modern development, stimulated by the most recent scientific researches and acquisitions in hygiene, economics, and politics. Through it, new methods of study have developed, by which not only the typical trade diseases but all the factors which bear upon the health conditions of wage-earners are estimated and studied clinically and experimentally. . . .

"Modern pathology thus unites study of fatigue and nutrition with the most recent theories of predisposition to infection induced in formerly healthy organisms. It reconciles the very latest theories of neuro-pathology with the latest ideas about the neurasthenics of labor. While it does not attempt to invade the other branches of medicine, it does draw from them facts and data with which to re-enforce its own postulates on social economic methods. This most modern development may appear to some too vague and general, to others too restricted, but it is certainly gaining ground and growing continually more complete and definite."

This new emphasis is likewise shown in the able little Italian monthly called *Il Ramazzini*, from which the above is quoted. This is a journal of social medicine, started in 1907. In the admirable bibliographies of current socio-medical-literature which *Il Ramazzini* publishes for the International Commission on Trade Diseases (founded 1906),

* *Il Ramazzini.* Giornale Italiano di Medicina Sociale. Anno I. Fasc. 12. (December, 1907.) Giglioli, Dr. G. Y. (R. Istituto di Clinica Medica, Firenze): Nuovo Ricerche e Nuovo Conquiste nel Campo della Patologia e del' Igiene.

prominent place is given to the section headed "Surmenage," or exhaustion.

In the "pathology of labor" belong indeed the trade diseases with their train of temporary and chronic ills. But the first place is taken by those disturbances of metabolism, those self-generated poisons of fatigue, which are common not only to workers in so-called dangerous occupations, but to every man, woman, and child who breathes and works.

9. OPPORTUNITIES FOR SUCH STUDY IN THE UNITED STATES

In the almost total absence, in this country, of medical emphasis upon the pathogenic nature of industrial overfatigue, it is significant to read Professor Irving Fisher's note in his Report on National Vitality, prepared for the National Conservation Commission. He says:*

"The present working day is a striking example of the failure to conserve national vitality. . . . The fatigue of workmen is largely traceable to their long work day. . .

"The relatively slight impairment of efficiency due to overfatigue leads to more serious impairment. Just as minor ailments prove to have an unsuspected importance when considered as gateways to serious illness, so the inefficiency from overfatigue is vested with great significance. Obviously, if overfatigue would be reduced to a minimum, this reduction would carry with it the prevention of the major part of minor ailments, which in turn would lead to a great reduction in more serious illnesses, and this finally would lead to a great reduction in mortality. A typical succession of events is, first fatigue, then colds, then tuberculosis, then death. Prevention, to be effective, must begin at the beginning."

Back of the great scourges and acute contagions, back even of the minor ailments which often precede them, lies the lowered vitality, the unbalanced metabolism, to which, as we have seen, overwork so largely contributes. Serious discussion or consideration of this fatal sequence among

* Bulletin of the Committee of One Hundred on National Health, No. 30, pp. 45 and 47, July, 1909.

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working people is rare indeed. It is touched on with peculiar insight by Dr. Edward T. Devine in his stirring presentation of a dark topic, "Misery and Its Causes."

From the point of view of social welfare, Dr. Devine holds the minor ailments responsible for far greater misery among the poor than has been realized or ministered to by the medical profession, in comparison with the great plagues and the more acutely contagious diseases.

"I suppose," he says,* "that no medical authority would think of grouping together such diseases as I have named (rheumatism, indigestion, influenza, colds, catarrh, bronchitis and constipation), as from the medical point of view they may have nothing in common; but for us they have this in common, that they increase to an enormous, though uncalculable, extent the sum total of misery which men, women and children have to bear; they prevent that enjoyment of the good things of life to which we are fully entitled for the extraordinary amount of hard work that we do, by the bounty of nature and the abundance of our inherited wealth."

It is a new thing to have such "minor" sufferings named as "altogether undervalued causes of misery." It is a new thing, too, to have their importance squarely faced, as follows:

"I challenge the medical schools and laboratories, the institutions of research and family physicians, as not having paid sufficient attention to these disabilities; but beyond this, and as a more fundamental diagnosis of the difficulty, I challenge society as having permitted here very grave maladjustments in not having appreciated the importance of ailments of this kind, and for this reason not having been willing to pay for the service of investigating their cause, their character and their cure, or for the service of treating them in time."†

Our study of fatigue would lead us to go a step farther than Dr. Devine. He is presenting, with keen and sympa-

* Devine, Edward T.: Misery and Its Causes, p. 84. New York, The Macmillan Company, 1909.

† Ibid., p. 83.

thetic insight, the causes of misery for the "out-of-health, out-of-work, out-of-friends." We are concerned primarily with the other end of the industrial scale—the overworked, the overstrained, the overwhelmed. We are regarding Work in a broad physiological sense. In the discussion which follows we shall narrow our field further to those for whom legislation is today most urgent and practicable, the working women and children in need of state protection. But at this point, in behalf of all human workers—just because they are human!—we would paraphrase Dr. Devine's words and challenge the medical schools and laboratories, the institutes of research and family physicians, as not having paid sufficient attention to industrial overstrain and the intolerably long hours of labor, which, through the actual poisons of fatigue, must be regarded as breeding and augmenting the so-called minor ailments of working people.

And beyond this, and as a more fundamental diagnosis of the difficulty (to paraphrase Dr. Devine further) we challenge society as not having appreciated the importance of industrial overwork and exhaustion, and for this reason having allowed them to persist from generation to generation without study of their effects or of the violence done to man's natural endowment—his physiologic mechanism.

Abroad, a new correlation of such scientific study and the industrial régime has at least begun. It has not yet gone as far as has the scientific scrutiny of overwork in school children. Such observation of school children—their capacities, attentions, fatigues—has in the last few years become a favorite theme of both pedagogues and physiologists. It is concerned chiefly with the fatigue of attention due to long school hours, and the reaction of such fatigue upon the child's total health. Scientific tests and measurements of fatigue in school children have accordingly been carried on for some years past with more or less success, and a vast amount of literature on the subject exists today.

For effective prevention, we need precisely a new study of undue fatigue in industry. Both for a more rational or-

ganization of business and for intelligent legislation we need definite knowledge of the effects of such industrial facts as those which we have briefly reviewed. We need to know, from systematic and continuous study, what are the actual results of speeding, and piece-work, monotony and mechanical rhythms, and the rest. The workday, as we have seen, is too long when it goes beyond physiological limits; in other words, when no adequate margin of rest is allowed for tissue repair. We need to know for the various trades, and for the various operations in those trades, what is an adequate margin of rest. We need to know whether nervous diseases are on the increase among industrial workers in this country as they are reported to be abroad. We need to transfer into the factory and workshop the investigations into fatigue which have yielded so rich a harvest in the laboratories. We need, above all, men of the highest caliber and professional standing to plan such investigations along broad inclusive lines, so as to discount what is transient and temporary, and to obtain the underlying facts, for the conservation of health and efficiency.

Many enlightened employers already provide medical supervision of the hygiene of their employes, in the interests of efficiency. These agencies could well be used for such systematic and continuous study as we have advocated. Once the importance of the subject is realized, once overstrain is recognized as *itself a danger of occupation*, study of overwork and its sequelæ must follow.

Another source of information on the effects of industrial overpressure has been hitherto unused. This is in the records of the clinics and hospitals where working people are treated. In this country we have not the opportunities afforded by the foreign insurance systems to study sick and convalescent wage-earners. But from the thousands of working men and women to whom the hospitals minister yearly, could they not learn those antecedent facts as to the strain of employment to which, as we have seen, foreign insurance physicians have been forced to turn in the interests of prevention?

The social service work established in connection with various hospitals, precisely for prevention, is a first step in this direction. The out-patient department in many hospitals follows patients into their homes in order to make sure that the benefits of hospital treatment are not immediately undone by unhygienic living. This work could well be supplemented by obtaining and keeping accurate records of the industrial as well as the medical history of patients. No better work for prevention could be done than by attempting to discover those elements in industry which contribute directly to the illnesses of thousands of workers and carry them year by year in throngs to the hospitals.

Through the nurses who visit patients in their homes and establish confidential relations with them, the machinery for such an additional inquiry is available. The medical examination and record of patients at the hospitals give their physical histories in full. An invaluable additional body of information could be secured if detailed records were systematically kept during a series of years showing the previous trade history of patients: their previous hours of work, the length of overtime work at rush seasons, their night work if any, the machinery or processes at which they were employed before illness, and many similar questions. These histories, to be accurate, would have to be corroborated by a separate industrial investigation of previous places of employment, to confirm the workers' accounts of themselves. Such an investigation could be kept within manageable limits by confining it to the year or two years previous to the workers' illness.

To learn and to accumulate the histories of patients suffering from specific trade diseases would obviously throw light upon many dangerous occupations and dangerous processes of manufacture as yet unstudied in this country. To learn and accumulate the histories of those who have been the victims of industrial overpressure would be a no less valuable contribution to the complex study of industrial fatigue. This can never be done by collecting a few cases. The

value of such an investigation would be cumulative, if it could prove, after a series of years, by large numbers of individual and well authenticated cases, the important part played by overstrain in the production of disease and ill-health among wage-earners.*

Such case study of wage-earners who have succumbed to illness has a marked advantage over the more general study of wage-earners at work. What we seek to know is precisely what is implied in the Italian phrase "the pathology of labor." Just as in medicine the study of pathology goes hand in hand with the study of physiology—the morbid as well as the normal reactions often yielding most suggestive clues—so in industry, not only the physiological but the pathological aspects must be scrutinized: the infections, anæmias, nervous disorders, pelvic derangements in women, and the rest.

It is, in the last resort, those who succumb who must determine the dangerousness of any trade. Thus, for instance, many men no doubt can and do work in caissons, without contracting the dreaded "bends." Yet the legislation which prescribes special rules of hygiene for caisson work is based on the victims, not the survivors. Hence it is essential to learn from a scientific observation of the victims of industry —possibly in hospitals and clinics as suggested above—those unhealthful and dangerous processes of industry which lead to physical disaster.

* The beginnings of such an investigation into the trade history as well as the home life of clinic patients is related in the last report of the Social Service Department of the Massachusetts General Hospital (Jan. 1, 1911–Jan. 1, 1912). Eighty working girls who had applied for medical relief during eight months, were studied.

V

ECONOMIC ASPECT OF REGULATION: FATIGUE AND OUTPUT

IN the previous chapters we have found in the laws of fatigue a scientific basis for legislation, and an explanation of the effects of overwork on *health*. We may proceed now to seek in the same physiological laws an explanation of the effects of overwork on *output and production*. To understand the economic as well as the physical effects of regulation, we must turn back to those physiological truths on which both alike are based.

We have sought to bridge the gap between laboratory and factory, and to show how work, whether it be the leg jerk of the frog in scientific experiments, or the contractions of our human muscles in industrial processes, results in chemical reactions within the workers' tissues. Now we must turn from the person of the worker to his accomplishment, from study of the performer to a scrutiny of his performance.

Just as the methods of the laboratory have yielded suggestive analogies in estimating the subjective fatigue of the worker, so they help to estimate the objective value of work accomplished. The diagrams, or curves of work, recorded upon the sooty drum at the laboratory, represent not exactly but symbolically the fluctuations of what is known in industry as output, or production. They explain why long and late hours of labor must physiologically result in lessened output.

This is the more important because regulation of the length of working hours has been so bitterly contested by those who feared that any lessening of the hours of labor meant a corresponding economic loss. From the first dawn

of protective legislation in England over a century ago to the present day, the rallying cry for the most diverse-minded opponents of legislation has been the threatened ruin of industry and manufactures. Solemn or hysterical, an honest conviction, hypocritical, pseudo-scientific, this cry has been more or less successfully invoked in every country, at every attempted advance, bringing with it all the rancors and bitternesses through which the cause of legislation has been dragged. Yet the unconscious consensus of testimony from various states and countries on the economic benefits of the short day, recorded in official and unofficial documents, is in its turn as impressive as we found the unanimity of evidence on the physical effects of the long day.

For the most part, however, all this body of information is ignored and allowed to fade into the limbo of forgotten things, in our practical efforts at legislation. We must keep reiterating that the unsolved questions and difficulties are of fundamentally the same general character today as in the past. Practically the world over, the state of the sweated trades in 1912 is "closely parallel to that of the Lancashire cotton mills in 1802." To come nearer home, factory legislation in Pennsylvania, New York, and other American states has not yet reached the stage of British textile legislation of more than sixty years ago. And most significant of all, it is still the cry that industry will be ruined by protecting the workers, which most hampers our advance.

It is the cotton lobby which throws its great influence against the workers in the cotton states, the glass lobby in the glass states, the laundrymen's association wherever legislation for laundry workers is proposed, the retail dealers' association against any relief for shop girls. Individual employers, it goes without saying, are humane and enlightened, but their official organizations and representatives have won a sinister distinction in opposing labor legislation. Such associations of employers as those named above, are found officially in the field at every session of the state legislatures. It was, for instance, the Illinois Manufacturers' Association

which officially combatted any restriction whatsoever of women's hours in Illinois, and, failing to defeat the passage of the ten-hour law in 1909, bent all their energies to have the law annulled by the courts. It was the laundrymen's associations which played the same part in Oregon in 1907, and even carried a case against the Oregon ten-hour law to the United States Supreme Court. It is the Retail Dry Goods Merchants Association of New York City which by varied means has succeeded in stifling all limitation of hours for adult women employed in department stores. It was the official Manufacturers' Association of Colorado which issued a statement to the legislature in 1911, pointing out the dangers of the proposed eight-hour law, and denying its need by recounting the contributions of Colorado manufacturers to various charities. The universal argument which has so often crowned their official efforts with success is the abject money-makers' plea, the fear of loss—"Save us lest we perish."

As the authors of the standard history of factory legislation have said, writing with what Mr. Sidney Webb calls "commendable restraint," as "historical students":*

"In the beginning, the proposal to restrict children to a working day about 30 per cent longer than strong men now think good for themselves, was greeted almost hysterically, and the ruin of trade and commercial collapse of the country were freely prophesied as the necessary result. Inquiry after inquiry, commission after commission, have demonstrated the groundlessness of these rather unmanly terrors, yet the Factory Code is still the barest minimum and scarcely ever is there a discussion in Parliament on the subject that does not reveal that the masses of information and material that exist for the full economic justification of further measures are practically unknown to all but a select few of our legislators."

1. GENERAL EXPERIENCE IN ENGLAND

As far as our immediate subject is concerned,—the relation between fatigue and output,—the testimony of history

* Hutchins, B. L., and Harrison, A.: History of Factory Legislation, p. 253. London. P. S. King and Son, 1903.

is continuous and impressive. In England, for instance, whose industrial experience is longest and most fully recorded, the cry that legislation would ruin the country united men of the most scattered beliefs and parties to oppose the Ten Hours Movement. The long file of Parliamentary Debates from 1832 onward gives vivid glimpses of the conflict that raged, while industrialism was bursting into life, after the long European wars. The Napoleonic bogie had been laid. The ports of Europe were open again to British commerce. Watt's steam engine, patented in 1769, had advanced into general use. The day of industrialism had come. Terrible as is some of the testimony in the Debates, showing the ugly domination of men's humaner instincts by greed, and the almost intolerable slowness with which nineteenth century empiricism treated each separate abuse as a single issue, unrelated to any general principles of protection, yet these debates are seldom remote or academic. They are vivid cross-sections of British history, pulsing with life.

We see the Earl of Shaftesbury, then Lord Ashley, standard-bearer of the cause, in the great debate of 1844 stung from the lofty tone habitual to him in combatting oppression. Once too often his opponents had flung the foolish taunt that he was attacking commercial interests merely as the representative of a different social class, a taunt not unknown to reformers today. "Most solemnly do I deny the charge," began Lord Ashley, and breaking into anger:

> "If you think me wicked enough, do you think me fool enough for such a hateful policy? Can any man in his senses now hesitate to believe that the permanent prosperity of the manufacturing body . . . is essential, not only to the welfare, but absolutely to the existence of the British Empire?"*

We see Bright and Hume and Cobden, leaders of the Manchester School, opposing what they called the "interference" of the government (a still familiar cry!) as certain to bring ruin upon manufacture. These men were fighting,

* Hansard's Parliamentary Debates, 3rd Series, Mar. 15, 1844.

we must remember, the battles of free trade. The struggles for the Factory Acts and for free trade were practically synchronous. The Corn Laws were repealed only a year before the final passage of the Ten Hours Bill (1847), and the political economists denounced in one breath government regulation of working hours and government monopoly of trade, on philosophic grounds of *laissez faire.*

"The people ask for freedom in their industry," cries John Bright in 1844,* "for the removal of shackles on their trade; you deny it to them and then forbid them to labor as if working less would give them more food whilst your monopoly laws make food scarce and dear. Give them liberty to work, give them the market of the world for their products."

Yet, on the whole, this opposition to the ten-hour movement did not center on abstract ideas of freedom or philosophy. It was much more practical and modern. Men did not vote on any party lines—Whigs, Tories, and Radicals were all intermingled.† As has been well said, the issue resolved itself into what we may term the optimistic argument, asserting that the alleged overwork was grossly exaggerated (again, how familiar a defense!) and the commercial argument which pleaded that the manufacturing interests would be bankrupted by the proposed restriction to ten hours.‡

This was indeed long held to be the vantage ground of the opponents of restriction,—the dire consequences which must follow the curtailment of the last two hours of the twelve-hour day.

* Hansard's Parliamentary Debates, 3rd Series. March 15, 1844.

† A wellknown passage in Greville's Memoirs describes the confusion: "I never remember so much excitement as has been caused by Ashley's Ten Hours Bill, nor a more curious political state of things, such intermingling of parties, such a confusion of opposition. . . . So much zeal, asperity, and animosity, so many reproaches hurled backwards and forwards. . . . John Russell, voting for '10 hours' after all he professed last year, has filled the world with amazement. . . . The opposition was divided, Palmerston and Lord John one way, Baring and Labouchère the other. It has been a very queer affair." Memoirs, Vol. II, pp. 236–237. Longmans, Green and Co., London, 1885.

‡ Hutchins and Harrison, op. cit., p. 88. Second Edition. 1911.

No one issue in labor legislation has been more befogged by prejudice and passion than this relative productivity of late working hours. The question arose at the very outset of the industrial era in 1837, when the economist Senior put forth his long-lived economic fallacy that profit depends on the output of the last hours of work, and that, consequently, profits would be destroyed if the eleventh or even the twelfth hour of work were curtailed.*

This superstition has died hard. No contention did more to retard the reduction of the twelve-hour day in England. It seemed plausible enough to men, in the first flush of invention and industrial expansion, who looked on human labor as a mere adjunct to the machine. For obviously, with machines every additional hour of operation means additional profit. The fixed charges of installation and operation —rent, taxes, and the like—are not increased proportionally by added hours of operation; hence the last hours were supposed to represent clear profit after expenses had been met by the earlier hours of work. It was passionately asserted that the commercial supremacy of England hung on the last one or two hours of work, which gave the profits.†

Senior's extraordinary argument was introduced verbatim in Parliament by Mr. Milner Gibson in 1844, as "sound and indisputable." If the manufacturer's profits were destroyed by cutting off the last two hours of work, he said, the laborer was in effect deprived of earning his means of subsistence. Articles and arguments for and against Senior

* Senior, Nassau: Letters on the Factory Act. London, 1837.

† "The following analysis will show that in a mill so worked (twelve hours a day and nine on Saturday, according to the Act of 1833) the whole profit is derived *from the last hour*. I will suppose a manufacturer to invest £100,000—£80,000 in his mill and machinery and £20,000 in raw material and wages. The annual return of that mill, supposing the capital to be turned once a year, and gross profits to be 15 per cent, ought to be goods worth £115,000, produced by the constant conversion and reconversion of the £20,000 circulating capital from money into goods and from goods into money in periods of rather more than two months. Of this £115,000 each of the twenty-three half-hours of work produced 5/115ths of 1/23rd. Of these 23/23rds (constituting the whole £115,000), 20, that is to say, £100,000 out of the £115,000, simply replace the capital; 1/23rd (or £5,000) out of the £115,000 makes up for the deterioration of the mill and

raged in the daily and weekly press as well as in Parliament. Even ten years later, just before the ten hours bill was to pass in 1847, we find Joseph Hume making an impassioned appeal still based on Senior against interference with "fixed capital." He concurred in the clear and satisfactory arguments of one whom "he was proud to call his friend," that

"ten hours paid only the expenses of the 'plant' and the wages of labor, and that if work stopped at ten hours, there would be no profit on the capital invested. . . . . The surplus, then, whether it was one, one and a half or two hours beyond ten hours, was the only time from which a remunerative return for capital could be made, without which it could not be expected that men would carry on business."*

But the irresistible logic of events was already beginning to overcome these specious arguments. Senior's theory was not, in the long run, borne out by practice. The human element, ignored in the theory, asserted itself practically, and the "spoiled work" which had to be thrown away, or done over again the next morning, increased rapidly during the late exhausting hours of the twelve-hour day. As early as 1843 an inquiry made for the second Children's Employment Commission by Mr. J. L. Kennedy as to the cloth print works in Lancashire, Cheshire, and Derbyshire, showed how the system of long hours resulted in deteriorated output. One firm, for instance, tried to run their mill fifteen hours per day and found that after the first month output began to fall off in both quantity and quality. By the fourth month of the trial, the spoiled work had doubled, and production had

the machinery. The remaining 2/23rds, the last two of the twenty-three half-hours of every day, produce the net profits of 10 per cent. If therefore (prices remaining the same) the factory could be kept at work thirteen hours instead of eleven and one-half, by an addition of about £2,600 to the circulating capital, the net profit would be more than doubled. On the other hand, if the hours of working were reduced by one hour per day (prices remaining the same) net profits would be destroyed; if they were reduced by an hour and a half, even gross profit would be destroyed. The circulating capital would be replaced, but there would be no fund to compensate the progressive deterioration of the fixed capital." Senior, op. cit. Quoted in Hutchins and Harrison, p. 88.

* Hansard's Parliamentary Debates, 3rd Series, Feb. 10, 1847.

fallen from 100 per cent to 90 per cent. This they attributed to the gradual exhaustion of the workers.

"The amount of spoiled work increased to such an alarming degree that the parties referred to felt themselves compelled to shorten the hours of labor to avoid loss."*

Upon reducing the hours of labor, the proportion of spoiled work promptly fell and output rose again. This was indeed Lord Shaftesbury's great argument, and the argument of Robert Owen and others of practical experience: not only that production deteriorated in amount and quality during the last two exhausting hours of the twelve-hour day, but that the workers' total efficiency, their physical and moral powers, all were gradually impaired. The shorter day, on the contrary, released them before exhaustion arrived, and in the long run tended to preserve working capacity at a higher level.

Between 1844 and 1860 more and more evidence of this kind was accumulating. By 1861, the president of the economic section of the British Association for the Advancement of Science could write of the general agreement throughout the country that

"if there has been one change which more than another has . . . placed the manufacturing enterprise of the country on a safe basis and has conferred upon us resources against the effects of foreign competition which can scarcely be overvalued, it is precisely the changes which have been brought about by the . . . efforts to establish in manufacturing occupations a sound system of legal interference with the hours of labour."†

During this period many wellknown opponents of legislation who had foretold the destruction of British industry, such as Cobden, Mr. Roebuck, the Home Secretary Sir James Graham, and others, became converted. Mr. Roe-

* British Sessional Papers, 1843, Vol. XIII, p. 72.

† Reprinted in Journal of the Statistical Society, Vol. XXIV, 1861, p. 463.

buck's recantation is so vivacious and made so great an impression at the time that it ought in part to be quoted:

"Very early in my Parliamentary career, Lord Ashley, now the Earl of Shaftesbury, introduced a bill of this description. I being an ardent political economist, as I am now, opposed the measure . . . and was very much influenced in my opposition by what the gentlemen of Lancashire said. They declared that it was the last half hour of the work performed by their operatives which made all their profits, and that if we took away that last half hour we should ruin the manufacturers of England. I listened to that statement and trembled for the manufacturers of England, but Lord Ashley persevered. Parliament passed the bill which he brought in. From that time down to the present, the factories of this country have been under state control, and I appeal to this house whether the manufacturers of England have suffered by this legislation. But the Honourable member for Manchester (John Bright) still, I find, makes the same objection. He gets up and prophesies all sorts of evil if we interfere now; but he has kept out of view the evils for the prevention of which we are now about to interfere . . . Having prevented this misery in the one case, let us interfere to prevent it in the other."*

The chief agencies by which these real results of the acts were becoming known, were the reports of the factory inspectors. It was a step of quite unappreciated importance when in 1833 the first inspectors were appointed to enforce the act. Supervision by the local justices, as first enacted, had failed. The appointment of inspectors by the central government for the express purpose of enforcement has been well called "the turning point of legislation," a step "whose importance cannot be exaggerated."† It was one of the first instances of creating a special department of the central government to administer a particular act. The inspectors were also to keep the government informed of the condition of the factory population, the degree to which the laws were

* Hansard's Parliamentary Debates, 3rd Series, Mar. 21, 1860.

† Webb, Sidney, and Cox, H.: The Eight Hours Day, p. 199. London, W. Scott, 1891.

meeting the existing evils, and the like questions. Their reports were sent in to one of the secretaries of state twice a year or oftener. Hence it came about that there gradually became available a body of unprejudiced information,—an "invaluable continuous record of industrial conditions by trained observers, free from local bias and partiality, whose business it was to renew their visits at stated periods and note what changes took place within their view."*

This has been one of the most important services of the inspection force in England and on the continent. However short they may have fallen in the actual enforcement of the laws, owing to the great odds against them,—the hostility of employers and parents, the inadequacy of the laws and their own entirely inadequate numbers,—they have, at any rate, bequeathed to us an invaluable record of the actual effects of legislation. Those who favored the extension of the Act of 1847 and the inclusion of other trades, could at least point to the written accounts of what had been accomplished in one regulated industry. As other trades were gradually included by subsequent legislation,—print works, bleacheries, lace factories, hosiery, hardware, and so forth,—the factory inspectors continued to show how manufacture in the long run profited instead of suffering by regulation.

Human nature is such, however, that immediate profits tend to outweigh future benefits, which can be proved only in the long run. Immediate profits make a much more popular appeal, and have distorted the issue, time and again, in successive campaigns for the short day, in each industrial country in turn. It was no peculiarity of the English that they so often preferred the immediate returns of the long working day, so that after more than one hundred years of legislation the Factory Code must still be called a minimum of protection. The same higgling and the same specious arguments have been effective in Germany, in France, in Belgium, in the United States, and wherever legislation on working hours has been undertaken. Only repeated demonstrations

* Hutchins and Harrison, op. cit., p. 72.

and restatements of the true economic effects of short hours, by enlightened employers, factory inspectors, economists, and laboring men have at all offset the illusory immediate profits of the long day. England has the longest and most fully recorded industrial history; but the same sequence could be traced in the other industrial countries.

2. GENERAL EXPERIENCE IN THE UNITED STATES

In the United States the seeming paradox of larger output in shorter hours was clearly stated by the now classic report of the Massachusetts Bureau of Statistics of Labor in 1881. Agitation for some sort of legislative protection for working children began as early as 1825 in Massachusetts.* The first law applying to adult women was not passed until 1874. Six years after the Massachusetts ten-hour law went into effect, a full investigation under Carroll D. Wright showed that the cost of production had not been increased, nor had wages been lowered under the Massachusetts ten-hour day, as compared with the system of eleven hours and longer in neighboring states. The worker's increased efficiency more than balanced the curtailment of working time. Massachusetts with ten hours produced "as much per man, or per loom or per spindle, equal grades being considered, as other states with eleven and more hours, and also . . . wages here rule as high, if not higher than in the states where the mills run longer time."†

Even before the passage of the Massachusetts act in 1874, experiments in single mills proved the same result. In 1867 the Atlantic Mills at Lawrence cut down their working day from ten and three-quarters to ten hours. The wages were kept the same. Cost of production increased 2¾ per cent, and the output at first was reduced 4 to 5 per cent; yet the treasurer of the company testified before the Massa-

* Labor Laws and Their Enforcement, with special reference to Massachusetts, p. 4. Edited by Susan M. Kingsbury. New York, Longmans, Green and Co., 1911.

† Report of Massachusetts Bureau of Statistics of Labor, 1881, p. 457.

chusetts Committee on Labor in 1873 that after three and a half years with no change in machinery or in wages, the output of ten hours was "fully equal" to the output of the previous ten and three-quarters hours; the immediate improvement in the workers was such that the firm considered them the "best that have been in the mill for fifteen years," and work was more continuous and less interrupted throughout the year than ever before.*

The favorable operation of the Massachusetts law, reported in 1881, led to the passage between 1885 and 1887, of similar laws in other New England states,—Rhode Island, Maine, New Hampshire, and Connecticut,—and greatly influenced the trend of legislation in other states.

During more than a generation which has elapsed since Massachusetts took the first step, the well worn argument that industry would be ruined or must leave the state, has accompanied each advance in American legislation, yet in only one case has any law limiting women's hours of work been repealed.† Almost every amendment has been by way of strengthening the laws and further reducing the workday.‡

This fact is in itself presumptive proof of the economic success of these statutes. No one can suppose that industrial communities, all in comparatively close touch with one another and able to observe how the laws were affecting "business" in neighboring states, would deliberately continue, during more than thirty-six years, to undo their own commercial welfare by legislative enactments. Common sense refutes the thought. Rather have the opponents of legislation tried year by year to minimize and ridicule the economic benefits of the shortened day; but in spite of their misrepresentation and ridicule, the truth has prevailed.

* Argument of Hon. Wm. Gray on Petitions for Ten-Hour Law before the Massachusetts Committee on Labor, Feb. 13, 1873.

† The New Jersey law of 1892 providing a ten-hour day and fifty-five-hour week for women, was held repealed by the repealing act of 1904, which reorganized the New Jersey Department of Labor.

‡ The only retrograde action has been the decisions of certain courts concerning the constitutionality of laws limiting hours of labor. These are discussed in Chap. VIII.

In a general way it has gradually become recognized that shorter hours improve health, and that improved health and efficiency under the short-hour system is the basis of higher output.* The greater zest and generally increased capacity of the short-hour worker have been contrasted with the physical and moral exhaustion of the long-hour worker.

Can we now learn something more accurate about the effects of regulation upon industry today? Can physiology interpret for us the relative productivity of long and short days, as it has clarified the new strain of manufacture and commerce? What has physiology to do with production, fatigue with output, today, since the examples of thirty and forty years ago are now valuable chiefly for their confirmation of European experience and the influence which they have had upon past legislation?

3. AN EXPERIMENTAL STUDY OF OUTPUT

Before taking up the question of output in industrial establishments, we may gain some insight from a suggestive little investigation made by an Italian physiologist, Professor G. Pieraccini of Florence.† This study of output is not at all conclusive, since it deals with a very small number of experiments and workers. It is valuable chiefly in pointing out one method for future investigations. No generalizations can be based upon a few observations, and the ever variable human factor in production makes it a vastly subtle and complex question. Indeed, in a certain factory, the mere knowledge that they were being examined caused marked variations in the output of working girls under observation. But Dr. Pieraccini's study is at least an interesting attempt to find the relative productivity of the various hours of the day in selected employments, and it may well precede our

* See Part II of this volume, pp. 339–384.

† Proceedings of the First International Congress on Industrial Diseases, Milan, 1906. Pieraccini, G. (Arcispedale di S. M. Nuova, Firenze): La Curva della Produzione Utile Esterna Raccolta Negli Operai Manuali ed Intellettuali Sul Campo del Lavoro.

discussion of such statistics as exist, on the productivity of the long and the short day in industry.

Professor Pieraccini did not use any laboratory apparatus to measure the output of his workers, but compared its actual amount and quality at different hours of the day. He studied the output of five different kinds of manual workers, namely, a copyist, six diggers, four stone-cutters, two bullet makers, two nail makers, and ten compositors. The small number of experiments reported is somewhat compensated by the similarity of their results and their general harmony with the knowledge derived from laboratory experiments.

For just as we have seen diagrammatically in the laboratory, the sequence of treppe, maximum effort, fatigue, and exhaustion, so in these experiments we see how working capacity increases during the second and third hours of work, falling as fatigue gains towards the noon hour, rising again slightly after food and rest at noon, to decline more rapidly to a minimum in the afternoon.

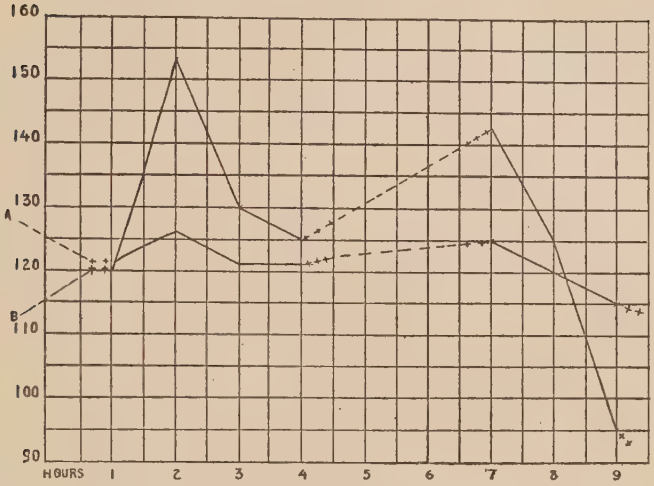
The most interesting figures are those given for the compositors or typesetters. The amount of their output was determined by the number of lines set per hour, while the number of typographical errors served to determine the quality of their work. The first experiment was made on six members of the Typographical Co-operative Society of Florence, experienced men working at piece-rates, for seven hours in the day. Their output was as follows:*

OUTPUT OF SIX TYPESETTERS WORKING AT PIECE-RATES SEVEN HOURS A DAY

Hours	*8–9*	*9–10*	*10–11*	*11–12*	*12–2*	*2–3*	*3–4*	*4–5*
Total	121	151	130	125	Rest and Lunch	142	124	96
Average	20.2	25.3	21.6	20.8	"	23.6	20.8	16

* Pieraccini, op. cit., p. 122.

Plotted, the curve is as follows:*



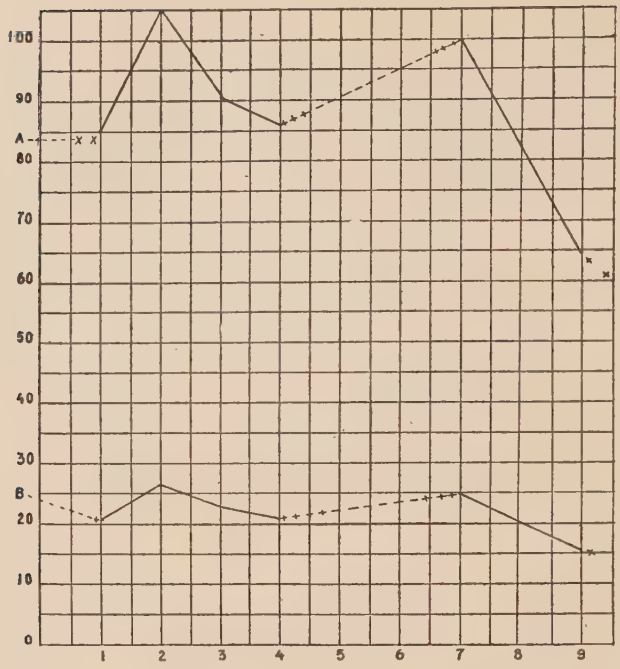
Similar is the showing made by four typesetters of the Niccolai Printing House at Florence. The errors made increase as work (i. e., the number of lines set) decreases. That is, the quality of the work falls just as the amount falls, with the increase of fatigue.

OUTPUT OF FOUR TYPESETTERS, SHOWING INCREASE OF ERRORS WITH INCREASE OF FATIGUE

Hours	*8–9*	*9–10*	*10–11*	*11–12*	*12–2*	*2–3*	*3–4*	*4–5*
No. of lines set								
Total.....	84	104	92	86	Rest	99	82	64
Average....	21	26	23	21.5	"	24.7	20.5	16
Errors.....								
Total	17	10	18.28	28	"	5.5	22.6	30
Average....	4.25	2.5	4.57	7	"	1.37	5.45	7.5

Plotted, the curve is as shown in the following chart.

*In this chart and the following one A=total output; B=average output.



The other experiments upon the copyists, diggers, stone cutters, nail and bullet makers, showed the same general results. The practice, or "limbering up," gained during the first hour of work makes the second and sometimes the third hour also the period of maximum production. In all cases the lowest output of the morning is reached during the hour before the noon rest. Output rises again markedly in the first hour of work after the noon rest, but it declines much more rapidly in the afternoon than in the morning. In no case does the afternoon output equal the morning's output in amount.

Inconclusive as these few figures are, and unsatisfactory in that they report total and average amounts of work instead of separate, individual amounts per worker, they at any rate point clearly to the close connection between the worker's

physical condition and his output. The rise in production in the first hour after noon marks the recuperative effect of food and rest. The lower productivity of the afternoon is the perfectly normal result of the worker's physiological fatigue, stemmed for a while by the noon break, but growing naturally through the functioning of his tissues, until quitting time and the night's rest restore the metabolic losses.

Through all the myriad variations of men's individual endowments, these general tendencies persist. Working capacity, like all human capacities, eludes perfectly fixed rules and measurements. Man's way of working is almost as individual as his thumb-print, fast or slow, steady or variable, tiring easily or tiring late, with as varying reserves of quite unmeasured strength. But all alike are subject to the physiologic laws, and this likeness which links all humankind is more fundamental, more important in our industrial inquiry, than all the peculiarities which differentiate.

So much for the underlying principles, and the very palpable connection between fatigue and output. As in sports the player's game shows whether he is "in form," "in trim," "in training," so in a sense, production is no more than a measure of the worker's fatigue or equilibrium. Work is still conditioned on the worker, in spite of all the marvels of modern machinery, planning, equipment, and the rest. And as a corollary, work, output, production, must rise or fall with the worker's physical fitness for his task. This is what we have seen repeatedly illustrated in the laboratory, and also in Professor Pieraccini's study analyzed above—a laboratory experiment transferred, as it were, into the factory.

Can we not find further confirmation in the actual operation of modern industries? Can we point to the relative productivity of the long and the short day in actual practice—their cash values in dollars and cents?

Unfortunately, exact data on this subject are meager and difficult to get. In this country few reliable and definite statistics are to be found. Many experiments in shortening

the hours of labor in various trades have yielded impressive results but have not been made public.

The increasing use of the stop-watch—a symbol of the new planning in industry, its infinitesimal accounting and record-keeping—is bound to show more and more new facts about men's diurnal efficiencies and the resultant individual and total records of output. But these studies, charts, and observations are so comparatively new (dating from approximately the last decade), and the nature of the results is held so confidential, that they have for the most part been kept private. Manufacturers are apt to hesitate or entirely refuse to publish the new saving in time, labor cost, and materials which result from new methods of organization. They regard them as business secrets, and fear competitors. Let us, then, first undertake to examine three wellknown and important foreign studies of efficiency which deal with conditions sufficiently like our own to be convincing and which throw considerable light on the economic effects of reducing the length of the workday.

4. THE EXPERIENCE OF THE SALFORD IRON WORKS AT MANCHESTER, ENGLAND

One of the most conclusive and influential of these experiments in shortening the day's work was made by the firm of Mather and Platt in 1893 at the Salford Iron Works at Manchester, England. This experiment is of particular interest because it was carried on during an entire year for the express purpose of measuring the effects of reduced hours, "to prove how far the widespread desire for shorter hours might be met without danger to the mechanical trades."*

The full complement of men at the Salford Iron Works during the trial year (March 1, 1893, to Feb. 28, 1894) was 1,200. The character of the work turned out was similar to that of the preceding six years; that is, general engineering

* Mather, Wm., M. P.: The Forty-eight Hours Week: A Year's Experiment and its Results at the Salford Iron Works, Manchester. Manchester, 1894.

work.* Since the firm was subject to keen competition in home and foreign markets, a detailed study was made of the effect of shorter hours on the cost of labor. In order to carry out the trial with scientific precision and care, extremely accurate comparisons were made by expert accountants. Mr. Mather vouches for the absolutely correct and trustworthy nature of the results, while he states that their confidential nature makes it impossible to publish all of the figures which were later given to the government officials. Previous to the trial year, the week's work was first fifty-four and then fifty-three hours, and the figures taken as standards with which to compare results are the averages, per year, of the previous six years.

The most noteworthy statement in the report is that under the forty-eight-hour week production increased.† Selling prices, moreover, were lower than in the previous years, so that during the trial year the cost of wages in proportion to "turnover" rose 0.4 per cent. Had selling prices remained the same, the cost of wages would have shown a decided decrease, instead of an increase of 0.4 per cent.

This debit against the trial year, however, Mr. Mather considers balanced by a saving of 0.4 per cent secured as a direct consequence of the shorter hours. The greater economy in consumables (gas, electric lighting, wear and tear, etc.) was closely figured and set against the increased fixed charges due to interest on plant and machinery, rent, taxes, etc. The balance of these two accounts was clearly in favor of the trial year. "By a remarkable coincidence," it showed a saving of 0.4 per cent on these items, which exactly counter-balances the debit of 0.4 per cent from the increased cost of wages.

Another item of interest to our special inquiry concerns

*This "comprised steam engines, pumping machinery, boiler work, etc.; all machinery used in those textile trades (other than spinning and weaving) for the bleaching, printing and finishing of cotton, linen, silk, and other fabrics; electrical machinery of every variety for lighting, transmission of power, electric traction, electro-depositing, electro-chemical processes, etc." Op. cit., p. 5.

† Op. cit., pp. 17 and 20. (Figures not given.)

the effect of shorter hours on piece-rates. It was assumed, at the outset, that the men on piece-work were doing their best, and that their earnings must be lessened by any reduction in hours. But though the piece-workers lost slightly during the year, their falling off diminished as the year advanced, showing a steady adaptation to the altered conditions of work. In order to judge the effects of the new system on piece-work, the year was divided into three approximately equal periods. In the first period, the surplus earned by piece-workers over day-work rates was 1.76 per cent less than the standard piece-work wages; in the second period it was 1.58 per cent less, and in the third it was 0.78 per cent less than the standard. This steadily diminishing loss made it reasonable to expect that at the end of the year the difference would entirely disappear, and that under reduced hours the piece-workers would earn exactly as much, hence produce as much, as in the longer day's work. Moreover, as the total output of the works was greater during the trial year than previously, the slight diminution in the piece-worker's production was more than compensated by increased production on the part of the day-workers.

In the light of our previous studies of fatigue and the strain upon men's energies in overwork, it is extremely significant that the management of the Salford Iron Works attributed the maintenance of full production during the trial year "solely to the *unimpaired and cheerful energy* on the part of every man and boy throughout the day."*

"We seem," says the report (and the statement is the more impressive because this investigation was not primarily concerned with the workers at all, but with the effect of shorter hours upon the output of "one of the great staple trades of the country" centering in Lancashire and Yorkshire), "we seem to have been working in harmony with a natural law, instead of against it. . . . The most economical production is attained by employing men only so long as they are at their best. When this stage is passed, there is no true economy in their continued work."†

* Italics added.

† Op. cit., pp. 25 and 26.

As one result of the "unimpaired and cheerful energy" of the workers under the forty-eight-hour system, the improvement in respect to "time lost without leave" is an important item. Under the fifty-three-hour system, the proportion of such "time lost" to the total time worked averaged 2.46 per cent, while under the new arrangement it was only 0.46 per cent. This loss of time meant, of course, a serious inroad upon production, and the greater "promptitude," "steadiness," "life and spirit about commencing work," reported by the foremen of various departments* aided in bringing about the success of the forty-eight-hour week.

Eleven years after this experiment was tried, the United States Bureau of Labor inquired of Messrs. Mather and Platt whether their works were still upon an eight-hour basis, and received a reply dated May 24, 1904, stating that "our experience since the first year in which it (the eight-hour system) was tried has fully borne out the conclusions then arrived at, and we are fully satisfied that as regards the comparison between eight and nine hours per day, the balance of advantage is in favor of the shorter period."†

An interesting sequel to the success of the forty-eight-hour week at the Salford Iron Works was Mr. Mather's determination, as a matter of public duty, to lay the results before the heads of various government departments. The then secretary of state for war, Mr. Campbell-Bannerman, the first lord of the admiralty, Earl Spencer, and the postmaster general, Mr. Arnold Morley, invited Mr. Mather to explain the workings of the forty-eight-hour week to the chiefs of construction from the Woolwich Arsenal Works, and to the officials of the dockyards and the post office.

Subsequently, in 1894, the hours of labor of about 43,000 work people in government factories and workshops were reduced to an average of forty-eight hours in the week.‡ Of

* Op. cit., p. 79.

† Bulletin of the New York State Department of Labor. No. 25, June, 1905, p. 240.

‡ British Board of Trade Labor Gazette, July, 1905.

these, 18,641 workers in war office establishments had their working time shortened by five and three-quarters hours per week.*

In 1905, eleven years later, the war office stated that when the forty-eight-hour week was first introduced, the results of experiments tried out in private factories had led them to expect a saving in time through the greater promptness of men in stopping and re-starting work, a greater regularity of attendance, and an improvement in the men's physical condition, with a consequent increase in working capacity. The communication states that

"these anticipations have been justified and it is clear that no extra cost has been incurred by the public on account of the reduction of hours, nor has the output of work been diminished. On the other hand, the majority of the workmen being on piece-work, the average weekly earnings per man have not been sensibly altered, although piece-work prices have not been increased. The day-workers received an increased hourly rate of pay to make their earnings per week of forty-eight hours equal to those per week of fifty-four hours. It was not found necessary to increase the number of day-workers."

So much for the economic results of the shorter week in the army establishments. The testimony from the admiralty is less specific and definite. In 1894, 24,263 workers in the royal dockyards, the royal naval ordnance department, and H. M. victualling yard had their hours reduced to forty-eight in the week. In 1905 the admiralty stated that the cost of production at the dockyards where most of the workers affected by the change were employed, compared favorably with the cost previous to the introduction of the forty-eight-hour week. But they were unable to state to what extent the cost had been affected by the reduction in hours, on account of improvements in machinery, changes in the methods

*This includes the Ordnance Factories, Ordnance Store Dept., Inspection Dept., Small Arms Inspection Dept., and Royal Army Clothing Dept.

of conveying stores within the dockyards, increases of pay in certain trades, and the like.

Such, then, was the result of one specific inquiry, fragmentary as it is, at the Salford Works, into the economic effects of the shorter workday. The later fruits of the experiment in shortening the hours of many thousand workers in government employ, give it an importance beyond its own narrower limits.

The Salford Iron Works and the government departments which followed its lead, settled on the forty-eight-hour week as the most profitable working period. Here we should state that, in this study of fatigue, we do not hold a brief for the eight-hour day, or for a day of any specified number of hours. Physiologically considered, even the eight-hour day is too long a period of work in some dangerous occupations. Sir Thomas Oliver, the leading expert on industrial poisoning, has recently reported that "a change from six- to eight-hour shifts of employment was in a Scotch factory found to be the only explanation of an outbreak of plumbism in a works which had hitherto been free."* Moreover, the eight-hour day, involving with the noon hour and time taken in traveling to and from home usually ten or eleven hours' employment, does not leave too great a margin of leisure for any persons who are to be citizens of value to the state.

But for the moment we are not concerned with the claims of this or that specified number of working hours. We aim merely to answer the questions we have set ourselves in this chapter: What has physiology to do with production, fatigue with output? Can we learn the relative productivity of the long and the short day in operation—their market value? The Salford Iron Works and the reduced hours of 43,000 workers in English government employment have given us our first reply. For the next, we turn to a careful Belgian investigation of efficiency.

* Bulletin of the United States Bureau of Labor, No. 95, July, 191. Oliver, Sir Thomas, M.D., F. R. C. P.: Industrial Lead Poisoning in Europe, p. 9.

5. THE EXPERIENCE OF THE ENGIS CHEMICAL WORKS NEAR LIÉGE, BELGIUM

In the year 1888 a joint stock company was formed in the Province of Liége, by a group of Belgian manufacturers of chemical products. The name of the company was La Société Anonyme des Produits Chimiques d'Engis. Its objects were two-fold: the reduction of zinc blend, and the simultaneous transformation of the liberated gases into sulphuric acid. The company's plant was located near a zinc works, and was designed to replace the latter's open air furnaces for the reduction of the blend, by a new system of muffled ovens. The old means of reduction (known as Freiburg ovens) allowed large volumes of anhydride of sulphur to escape, a gas peculiarly destructive to vegetation. The Engis Company installed the new system to save the payment of heavy damages to the vicinity and the waste of the gases liberated in the roasting process.

Originally, under the old system, work was carried on in twenty-four-hour shifts. Workmen were required to remain at their ovens from 6 a. m. to 6 a. m. on alternating days. Work was intermittent, and during the twenty-four hours on duty each man had time-off at irregular intervals, amounting to about seven hours in the twenty-four. This organization of work was naturally found intolerable, leading to inefficiency, exhaustion, and drunkenness among the workmen.

When the new stock company was formed, a twelve-hour workday was introduced. Each week the day shifts and night shifts alternated, thus providing a twenty-four-hour workday and a twenty-four-hour day of rest on alternate Sundays. But this schedule of work was also found unsatisfactory and inhumane, and after four years a fundamental change was determined upon. L. G. Fromont, the engineer who founded the Engis works and was its manager for more than a dozen years, has described in detail the final reorganization of his labor force from a two-shift to a three-

shift basis.* This meant the reduction of the workday from ten to eight hours—a change owing not to the demands of labor, but to M. Fromont's observation of the exhaustion (surmenage) of his workmen.

The special interest of this account lies in its statistical exactness and detail. Manifestly, in a dangerous occupation involving poisonous gases and extremest heat, the danger to health arises chiefly from the character of the work. But the statistics of output, wages, sick benefits, etc., under the twelve-hour and the eight-hour day show convincingly the part played by the reduction of hours.

The constant deficits of the sick benefit fund had become alarming. A mutual association had been formed at the first foundation of the company. It not only paid for medical attendance and drugs, but also a part of the salaries of sick workmen during non-employment. Accidents were not charged to this fund, as the company had from the beginning itself insured its workers against such hazards. But alarming as were the deficits of the sick benefit fund, the management was even more concerned by the manifest and daily increasing physical debility of their workers. (Nous fûmes bien plus alarmé encore de devoir constater, chaque jour, la décroissance manifeste de la résistance et de la vaillance de nos hommes.) During the heat of the summer a permanent relief shift was found necessary, to assist or relieve men overcome by exhaustion at the furnaces and incapable of continuing their work.

The chemical works had had considerable difficulty in recruiting their force. They needed the strongest and most robust of workmen. But in that part of Belgium where the Engis plant was situated, the traditional strong man's trade was brickmaking. It was a trade bred in the bone of the countryside. During the inclemency of winter, the brickmakers would betake themselves to other work in mines or

* Fromont, L. G.: Une Expérience Industrielle de Réduction de la Journée de Travail. Instituts Solvay. Brussels et Leipzig, Misch et Thron, 1906.

mills; but with the first harbingers of spring (dès que les premières hirondelles ont faits leur apparition) they were seized with a longing for their own trade (la nostalgie du métier) and despite promises and good intentions, they were off to work in the sun and open air.

Notwithstanding their superior strength, therefore, the Engis Company was compelled to accept workers of inferior physique but of steadier working habits than the brickmakers. When after four years their labor force showed unmistakable signs of failing and breakage, the company considered the feasibility of importing a sturdier race of foreign workmen. But unlike less scrupulous employers, the suggestion did not meet with favor amongst them. It seemed to the management unjust to their well-intentioned laborers, as well as an unintelligent effort to dodge the difficulty. The true solution, M. Fromont felt, lay in imitating the almost incredible feats of science (des vertigineux progrès de la science) which have transformed into servants of the human will the most formidable energies and forces of destruction. The company's difficulties could not be solved by systematically locking out the natural labor supply (le rejet systématique de la main-d'oeuvre qui s'offrait à nous), but by attempting o modify the hardships of the trade (en essayant d'assouplir aux circonstances, les exigences de notre industrie).

It was for this purpose that the three-shift system was introduced and the workday curtailed to eight hours.

Professor Ernest Mahaim of the University of Liége, a prominent Belgian economist, summarizes the results of the changes as follows:

"In the eight-hour day, representing seven and one-half hours of actual work, the same workman at the same ovens, with the same implements and raw material, produced as much as previously in twelve hours, representing ten hours of actual work."

How, now, were these results ascertained? They are described by M. Fromont with scientific accuracy and con-

ciseness in a series of extremely interesting charts (see pages 150–154), first communicated in 1897 to the Belgian Chemical Society and the Association of Engineers of the Liége School.* The probable effect of the reduction of hours upon output, wages, etc., was first plotted in advance, and then compared with the actual effects of the shortened day.

The interest of the experiment, says M. Fromont, was all the greater because the results of the change could be graphically and exactly demonstrated. The output was of a kind which could be measured by weight, and the same unit of measurement showed the variation of wages, since they were fixed by the amount of metal extracted.

Under the old régime the furnaces were in operation twenty hours in the twenty-four and empty four hours, while under the new they were in operation twenty-two and one-half hours and empty only one and one-half hours. A gain of two and one-half hours' time in twenty-four, or 10.5 per cent, was thus achieved. In seven and one-half hours' work the increase was therefore

$$\frac{10.5 \times 7.5}{100} = 0.7875 \text{ hours} = 48 \text{ minutes.}$$

What increase of output per man might now be expected as a result of this gain in working time?

While the work was carried on in two shifts, the men were on the premises twelve hours, representing ten hours of actual work. Their daily output per man was 1000 kilos of roasted ore or 100 kilos per hour. Under the new system, the men were on the premises eight hours, representing seven and one-half hours of actual work. At the old rate of production their output would thus be 750 kilos per day. But as we have seen, the three-shift system had resulted in a gain of two and one-half hours' work in the twenty-four hours. Hence it was estimated that during the twenty-four hours a proportional increase of output might be expected of

$$2.5 \times 100 = 250 \text{ kilos.}$$

* Bulletin de l'Association des Ingénieurs sortis de l'Ecole de Liége. Séance du 11 juillet, 1897.

Dividing this total gain among the shifts gives

$$\frac{250}{3}=83 \text{ kilos increase for each shift.}$$

Hence each shift's work was estimated at $750+83=833$ kilos per seven and one-half hour day of actual work, or

$$\frac{833}{7.5}=111.1 \text{ kilos per hour.}$$

In another way a similar estimate was reached. The new three-shift system had resulted in increasing the shaking-down of the furnaces by 20 per cent. In reducing the ore, any increase of shaking-down favors oxidation and the reduction of the blend. Hence a proportional increase of 20 per cent in the extraction of metal was to be expected.

The amount of extracted metal had under the old system been 2,000 kilos per day. The daily increase was therefore estimated at

$$\frac{2.000\times 20}{100}=400 \text{ kilos.}$$

Again dividing this estimated daily increase among the three shifts gives

$$\frac{400}{3}=134 \text{ kilos per shift.}$$

Hence each shift might be expected to produce $750+134=884$ kilos of roasted mineral. Taking the round number of 890 kilos, this would give

$$\frac{890}{7.5}=118 \text{ kilos per hour.}$$

From these and similar calculations it was determined that 830 kilos could easily be reached as the daily minimum, and that 890 kilos might reasonably be expected.

Such were the expectations and estimates of the management. The inauguration of the new system was difficult. It was bitterly opposed by the workers. They saw in the reduction of hours only a certain curtailment of production and lowered wages. The estimated increases were received with scornful (le plus méprisant) scepticism. At their previous wage of .40 francs per hour, the men were convinced

that they would receive only $7.5 \times 40 = 3$ francs per day. The most energetic measures, together with incessant and patient persuasions, were needed to overcome the workers' misconceptions and ill-will (eurent finalement raison du mauvais vouloir des ouvriers). They finally yielded to the evidence of fact. For little by little, under the new system, the daily output increased and the management's estimates were not only realized, but surpassed. In less than six months after the experiment was inaugurated, the workers had *equalled* in seven and one-half hours the previous output of ten hours, and the daily wage for eight hours' work equalled the wage previously earned in ten hours.

Charts I and II (page 150) show the estimated and actual results of the shortened workday. The dotted lines represent the estimates, the solid lines the actual achievements. Since the output of seven and one-half hours *equalled* the output of ten hours, or 1000 kilos, instead of 890 kilos as expected, we obtain in Chart I the curve $R\ M$, instead of the estimated drop RN. The curve of earnings $R'M'$ in Chart II is identical, wages being paid by the amount of ore extracted, or at 4 francs per thousand kilos. In both output and earnings the increase over estimates accomplished in the eight-hour day was 12.4 per cent.*

Under the old system, the alternation of day and night shifts required a double workday of twenty hours by each shift on alternate Sundays. The output of this double day had never equalled twice the output of the ordinary ten-hour day or 2000 kilos, but always fell to 1600 kilos.

Under the new system, the long Sunday fell to the lot of each shift only once in three weeks instead of every fortnight, and the double day was fourteen and three-quarters hours instead of twenty. It was computed in advance that the workers would accomplish twice their daily output of 890

* Fromont, op. cit., p. 78.

$$\left.\begin{array}{ll} \text{As regards output} & \frac{110 \times 100}{890} \\ \text{As regards wages} & \frac{44 \times 100}{356} \end{array}\right\} = 12.4 \text{ per cent.}$$

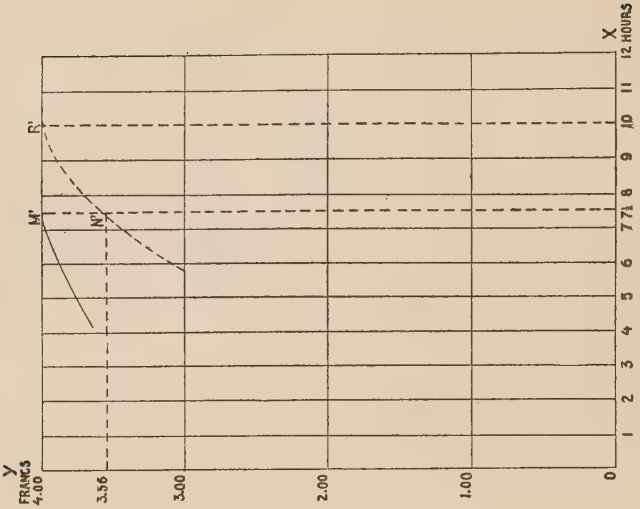


Chart II

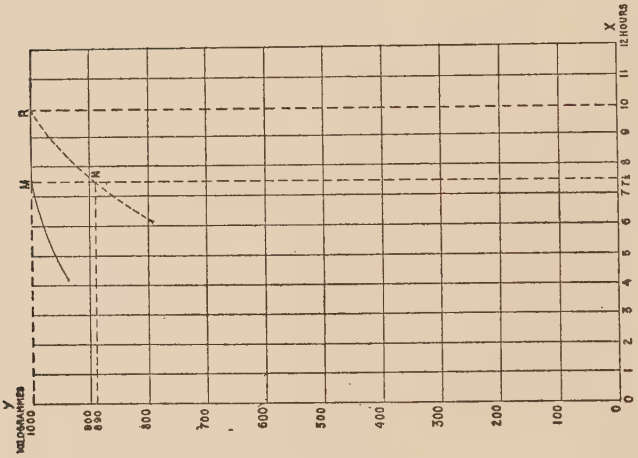


Chart I

kilos, or 1780 kilos, on the long Sunday, and accordingly would earn 7.12 francs. As a matter of fact they increased their output on Sunday just as on other days, reaching 2000 kilos and earning 8 francs.

Hence in Charts III and IV (page 152) we obtain the curves $S\,P$ and $S'\,P'$, instead of the estimated curves $S\,Q$ and $S'\,Q'$. These curves show an increase of 25 per cent, in both output and earnings, over the previous results of the twelve-hour day.*

The increase of output and wages *per hour*, compared to what had been expected in advance, is even more striking. Instead of producing 118 kilos per hour, the men accomplished 133 kilos, giving the curve $H\,K$ and H' and K' instead of $H\,L$ and $H'\,L'$ in the next two charts. (Charts V and VI, page 153.) These effects of the eight-hour day were 12.7 per cent greater than had been estimated, and 33.33 per cent greater than the output of the twelve-hour day.†

Another interesting chart shows the effect of the shortened workday upon the mutual sick benefit fund.‡ As we have seen, accidents were not charged to this account; the number of contributors remained about the same. Hence the progressive increase of receipts over expenditures seemed to M. Fromont proof of the beneficial and undeniable (heureuse et incontestable) influence of the eight-hour day.

The abscissas of the chart represent the years elapsed since the foundation of the company. The ordinates represent the annual excess of receipts over expenditures. The curve *npqroabcdefghiklm* shows the fluctuations of receipts

* Op. cit., p. 78.

$$\left.\begin{array}{l}\text{As regards output } \dfrac{400\times 100}{1600}\\[2ex] \text{As regards wages } \dfrac{160\times 100}{640}\end{array}\right\} = 25 \text{ per cent.}$$

† Op. cit., p. 79.

$$\left.\begin{array}{l}\text{As regards production } \dfrac{33.33\times 100}{100}\\[2ex] \text{As regards wages } \dfrac{133.33\times 108}{400}\end{array}\right\} = 33.33 \text{ per cent.}$$

‡ Op. cit., p. 82. See Chart VII, page 154.

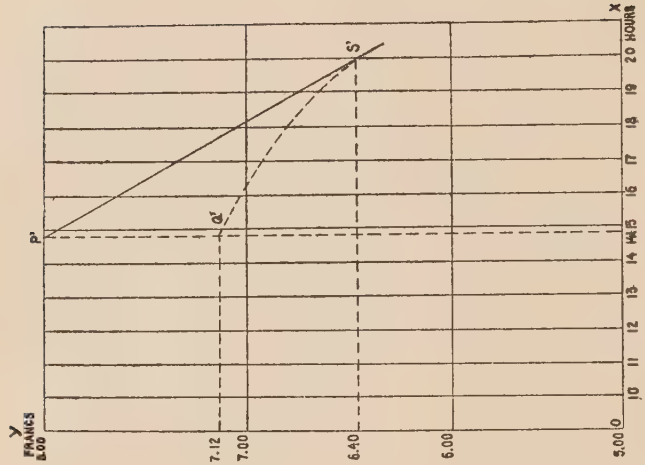


Chart IV

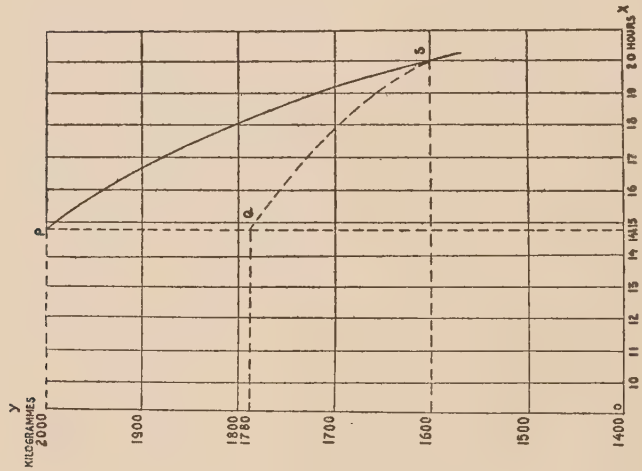


Chart III

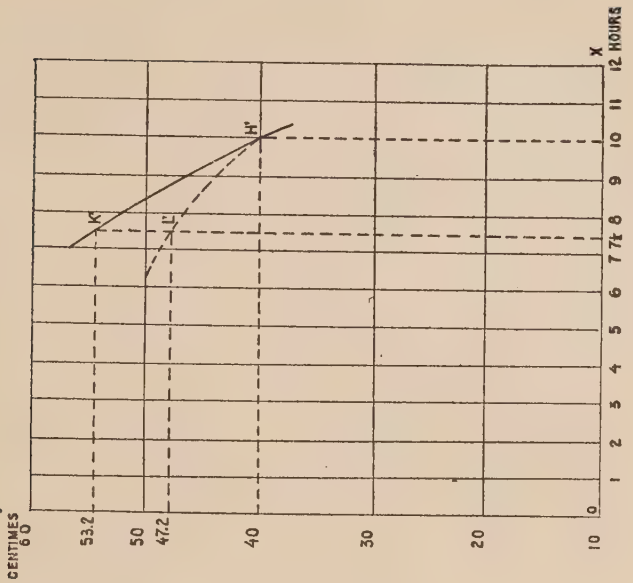


Chart VI

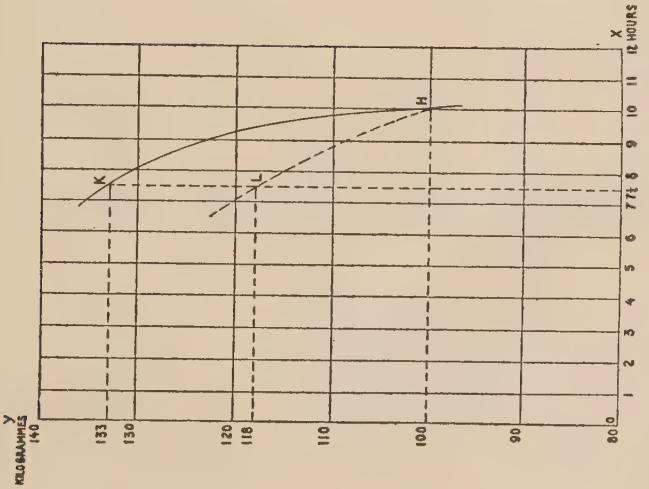


Chart V

and expenditures during a series of years. That is, the portion of the curve below the line *ox* shows that between 1889 and 1892 expenditures exceeded receipts; the portion of the curve above *ox* shows that subsequent to the introduction of the eight-hour day in 1893 the receipts tended to exceed expenditures progressively.

The pronounced drop in this line in the years 1895, 1900,

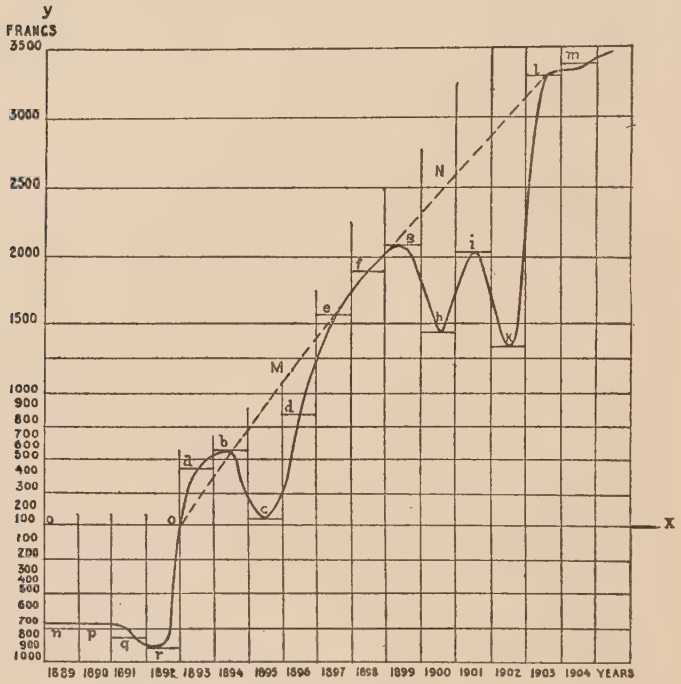


Chart VII

and 1902 (represented by the peaks, *c*, *h*, and *k*) is ascribed by M. Fromont to the epidemics of influenza which raged during those winters. He concludes that without exaggeration (sans pouvoir être taxé d'exageration) the improvement in health under the eight-hour system may be called progressive, as represented by the dotted line *obMefgNlm*.

In addition to this graphic chart, M. Fromont bears eloquent testimony to the new spirit of sobriety and self-respect which accompanied the shortened workday. Previously the strong stimulant of drink was found a daily necessity. The men's wives themselves provided it in the mornings (les malheureuses inconscientes) hoping to help their husbands to "repair themselves," in the picturesque language of the countryside ("se refaire des forces," suivant l'expression pittoresque des ouvriers). With the shorter workday the clandestine drinking in the factory was abandoned, and even outside of working hours drunkenness almost totally ceased. The men also acquired the habit of invariably washing and changing their clothes before leaving the factory—signs of a new personal self-respect.

Finally, M. Fromont describes in detail the effect of the reduction of hours upon the cost of production. Without reproducing his detailed statistics,* it suffices to state here that the overhead charges per ton of roasted ore fell 33.33 per cent. The total cost of production fell 20 per cent. Thus in the new organization of work technical perfection was not sacrificed nor neglected. The amount and quality of the output improved progressively, together with the moral and physical improvement of the labor force.

6. THE EXPERIENCE OF THE ZEISS OPTICAL WORKS AT JENA, GERMANY

We have purposely left to the last, for our fullest analysis, Ernst Abbé's classic study of the famous Zeiss Optical Works at Jena, Germany. This is, for our purposes, the most significant and valuable study of efficiency ever published, because Abbé, himself a physicist, university professor, and inventor of first rank, and the owner of a world-famous manufacturing plant, found himself driven to the conclusion almost naïvely stated by Mr. Mather when he wrote about the shortened workday: "We seem to have

* Op. cit., pp. 87–96.

been working in harmony with a natural law, instead of against it."

Abbé's social contributions were unique. They have received scant notice in this country, but abroad they are famous. Since his death in 1905, scarcely a serious review or scientific journal in Germany has failed to publish an appreciation of him (als Sozial Politiker); of his social schemes as well as his inventions in applied optics; and of his creation and endowment of the great Carl Zeiss Foundation at Jena, a model industrial organization.

Here we must confine ourselves to Abbé's remarkable study of industrial efficiency, set forth in two lectures before the Society for Political Economy of Jena in 1901.* Abbé died before he had opportunity to complete the more thorough (gründlich) study of efficiency which he had planned. He was certain that no thinking person (kein Denkender) could fail to be convinced by the relentless logic which links efficiency and the length of the workday. In the two lectures which he has left on the subject the reader is constantly impressed with this logical treatment of the argument. It is based on no *a priori* judgments, but deduced step by step, by a trained scientist, from thirty years' observations of a great industrial plant.

Abbé was born in 1840, the son of a hard working Saxon spinner. At Jena and Göttingen he managed to study the sciences, chiefly mathematics and physics. Later he became *docent* at Jena, and in 1870 was appointed full professor. He continued to lecture on physics and astronomy and to direct the astronomical observatory until his retirement in 1889.

Twenty years or more before he retired from the University, Abbé had become interested in, and had devoted his best efforts to problems of applied optics in the works of Carl Zeiss at Jena, where the construction of microscopes,

* Gesammelte Abhandlungen von Ernst Abbé, Bd. III, 1906. Die Volkswirtschaftliche Bedeutung der Verkürzung des Industriellen Arbeitstages, 2 Vorträge gehalten in der Staatswissenschaftlichen Gesellschaft zu Jena, 1901.

telescopes, and other lenses was being technically perfected. In 1875 Abbé entered the firm of C. Zeiss, and after the latter's death in 1888 conducted the business alone until 1896, when he handed over the management to his carefully constituted Carl Zeiss Foundation, remaining one of the directors until ill health forced him to retire a year or two before his death.

These bare facts of Abbé's career indicate how he was equipped to deal with the—to him—astonishing results in the efficiency of his workmen, when the workday at the Zeiss Works was abruptly changed in 1900 from nine to eight hours, a reduction of 10 per cent at one stroke.

When Abbé entered the Zeiss firm in 1870, the workday had been twelve hours long. It was gradually reduced, reaching nine hours in 1891. Nine years later it was further shortened to eight hours, for the same purpose as at the Salford Iron Works described above; that is, to discover the effect on output. The trial at the Zeiss Works was also limited to one year.

Abbé was familiar with the British experiments in reducing the length of the workday, and had been particularly impressed by the experience of the Woolwich Arsenal in changing from nine to eight hours without loss or decrease in output. The general similarity and consensus of English experience on the benefits of the short day to output, organization, and invention seemed to Abbé presumptive evidence of its truth. But he realized that specific statistical proofs of increased efficiency under the eight-hour régime were still needed, and he published the careful records and statistics of the Zeiss Works precisely to corroborate more exactly the general principles empirically learned in British mills and factories.

The effects of the change from nine to eight hours were measured by comparing the earnings of piece-workers during the year before and the year after the change. In order to make the comparison as accurate as possible and to eliminate chance variations, great care was taken to omit all workers

whose output might have been affected by special individual causes. The comparison was limited to workers who had been in the firm's employ four years, and who were over twenty-two years old. All workers were ruled out who had lost more than 300 hours during the year on account of sickness or other reasons. About 20 others were not counted because their health seemed below par. This left 233 workmen whose work during the trial year could fairly be compared with the year before and could be expected to show the effect of the reduction of hours. Thanks to the careful system of accounting, showing for years back the daily individual earnings of men at piece- and time-work, the following figures were available.*

COMPARISON OF HOURLY EARNINGS OF 233 PIECE-WORKERS IN THE ZEISS OPTICAL WORKS

In the last year of the Nine-Hour System (April 1, 1899–April 1, 1900) and in the first year of the Eight-hour System (April 1, 1900–April 1, 1901)

Year	*Total number Piece-work Hours*	*Earnings (in Marks)*	*Earnings per Hr. (in Pf.)*	*Ratio of Increase*
1899–1900	559,169 Average per man 2400	345,899	61.9	
1900–1901	509,599 Average per man 2187	366,484	71.9	100: 116.2

Now if the men, in eight hours, had earned exactly the same as in nine hours, piece prices remaining the same, then hourly earnings would have had to increase in the ratio of 8 : 9 or 100 : 112.5. But as a matter of fact, the hourly earnings increased in the ratio of 100 : 116.2. During the trial year, therefore, wages were *more* than equal to those of the previous year. There was an increase, as shown above, of 3 per cent. This means that in eight hours the daily out-

* Op. cit., p. 246.

put was one-thirtieth more than in nine hours. In other words, during the trial year 30 men did the work that 31 men had done previously. Each man did ten days' more work during the year of shorter hours.

This increase in efficiency was not confined to any one class of workers, nor was it particularly influenced by the ages of the workers. The following table shows the ages of the 233 workers under discussion, and how nearly uniform was their increase in efficiency in the shorter day.

INCREASE IN EFFICIENCY UNDER THE EIGHT-HOUR DAY OF 233 PIECE-WORKERS AT THE ZEISS OPTICAL WORKS.— CLASSIFIED BY AGES

(Ages were reckoned from April 1, 1900. Length of service reckoned according to years spent in the firm's employ after the eighteenth birthday)

Ages	*No. of Workmen*	*Average Ages*	*Average Length Service*	Average Piece-Rate Earnings per Hour in Pf.		*Ratio of Increase*
				9 Hr. Day	*8 Hr. Day*	
22–25	34	23.5	5.5	55.3	65.2	100 : 117.9
25–30	69	27.3	7.9	62.2	72.6	100 : 116.7
30–35	69	32.2	10.1	65.1	74.8	100 : 114.9
35–40	40	37.7	12.7	60.6	70.2	100 : 115.8
Over 40....	21	45.3	15.3	63.3	74.3	100 : 117.4
Total....	233	31.6*	9.6†	61.9	71.9	100 : 116.2

* Maximum 53, minimum 22 years. † Maximum 33, minimum 4 years.

A second classification divides the 233 workers in question according to their special kinds of work. It shows that the efficiency of all increased in about the same proportion, though the work ranged from the most delicate and highly skilled technical processes to the ordinary operations of wood-turning, polishing, etc.

INCREASE IN EFFICIENCY OF THE 233 WORKERS.—CLASSIFIED BY OCCUPATION

Occupation	*No. of Persons*	*Average Age*	*Average Length Service: Years*	Earnings per Hour in Pf.		*Ratio of Increase*
				9 Hr. Day	*8 Hr. Day*	
Optical Operations:						
1. Lense-setters: Fine hand work	21	31.1	12.7	72.8	84.9	100 : 116.6
2. Microscope grinders, etc.	20	33.2	13.8	79.1	86.5	100 : 109.4
3. Other hand grinders and centerers, entirely hand work	59	26.1	7.5	60.4	70.5	100 : 116.7
4. Machine grinders, entirely machine work	19	32.1	5.8	52.2	62.0	100 : 118.8
Mechanical and Auxiliary Work:						
5. Adjusting rooms, entirely hand work	22	31.7	8.2	65.5	76.7	100 : 117.1
6. Mounting rooms, chiefly hand work	20	36.9	11.6	66.6	78.5	100 : 117.9
7. Turning and milling, entirely machine work	23	35.2	11.1	57.6	68.0	100 : 118.1
8. Polishers and lacquerers, entirely hand work	17	34.7	11.2	53.8	63.3	100 : 117.7
9. Engraving, entirely hand work	5	27.2	6.8	56.1	66.9	100 : 119.3
10. Molders, entirely hand work	6	36.2	9.7	56.4	64.8	100 : 114.9
11. Carpenters, part hand, part machine	15	35.2	10.5	52.3	62.9	100 : 120.3
12. Case makers, chiefly hand work	6	30.4	6.4	55.7	62.8	100 : 112.7
	233	31.6	9.6	61.9	71.9	100 : 116.2

The most interesting fact that emerges from this table is that the largest increase in efficiency occurred in the coarser kinds of work. Groups 4, 7, and 11, which comprise almost entirely machine workers, showed the greatest improvement. Only one small group of 20 workers, highly skilled hand grind-

ers, did not produce or earn as much in eight hours as in nine. They failed by 3 per cent.

One more table of figures, and we can turn to the argument which Abbé based upon his statistics. He sought for corroboration of the astonishing fact that eight hours' work not only equalled but exceeded nine hours' work, and he found it in a perfectly objective standard of measurement; that is, the amount of power used during the four weeks before and four weeks after the introduction of the eight-hour day.

The 650 different machines in the Zeiss Works were driven by one central dynamo (not connected with the lighting). The amount of power used was determined by hourly readings of a wattmeter. In regard to the expenditure of power, Abbé makes a distinction between the actual amount *used*, when it is transmitted and the machines are in operation (der eigentliche Nutzeffect), and the so-called "waste" of power, when the plant is "running dead," as it is called; that is, when power is turned on and available but the machines are not in use,—as just before work begins, etc. (der sogenannte Leergang).

The wattmeter readings showed that during the last four weeks of the nine-hour system, the average amount of power transmitted per hour was 49.2 kilowatts. By a special contrivance it was shown that during this time, the hourly "waste of power" (the plant "running dead") was about half the total use, that is, 26 k. w. Thus the actual amount of power used averaged 23.2 k. w. per hour. After the eight-hour day was introduced the amount of power transmitted rose from 49.2 k. w. to 52 k. w. per hour. The actual amount used rose from 23.2 k. w. to 26.0 k. w. per hour; that is, in the ratio of 100 : 112. This shows that eight hours' work just equalled the previous nine hours' work, since, as we have seen before, for our mathematical basis, $8 : 9 = 110 : 112.5$.

But in effect, in many of the operations, the output not only equalled but exceeded that of the previous nine-hour

régime; and the wattmeter readings proved this also. For the majority of the machines in the works (three-fourths of them) were not wholly automatic. They were machines which the workers used like tools, using more or less power according to their intensity of application, by shortening pauses between operations, pressing more or less heavily in grinding and polishing, and in similar ways.

Hence the increased amount of power used in the eight-hour day, as shown by the hourly readings, was to be ascribed not to *all* the machines, but to three-quarters of the machines only. The ratio of increase for these, where the men regulated the amount of power used, was larger than the given figure of 100 : 112 which included *all* the machines. For three-quarters of the machines, the ratio of increase was higher; that is, as 100 : 116. In other words, they exceeded in eight hours by 3 per cent the output of the nine-hour day, confirming the conclusion previously proved by the earnings of the piece-workers.

Such being the evidence of cold statistics, the man of science in Abbé began to search for the causes. He examined the external conditions of work during the trial year and the year before. They had not markedly varied. The demand for Zeiss products and the consequent pressure at the works had been the same. There had been no extremes of heat or cold in the seasons, which, as he found, sometimes affect the output of highly skilled mechanics. In fact, the workers had for the most part been unconscious of their increased intensity of work. Many would not believe that they had produced more in eight hours than in nine until shown the proof. The figures showing the weekly amount of power used confirmed what Abbé learned direct from the men. Some had begun to work with feverish intensity when the new day was introduced, but had given it up in disgust after the first week, finding the effort exhausting. During the second week the output of these workers had consequently fallen below the nine-hour day; but by the third or fourth week they had recovered their normal pace, and unknown to

themselves, were equalling and surpassing the work of the longer day.

Abbé concluded that the adaptation of the worker to the shorter day, his intensity of application, was largely automatic, and did not depend primarily on his good or ill will. This was proved also by the firm's previous experience with overtime. Under the nine-hour régime, the men had been required to work one hour overtime at seasons of pressure. But it had been found that their efficiency did not keep up for any length of time. It fell off in about two weeks, in spite of the men's evident desire to earn the 25 per cent higher wages of overtime. One November Abbé himself had tried the experiment, when the men were eager to earn more just before Christmas. But the result was the same. The output of overtime deteriorated in one week, and by the third or fourth week it was practically nil.

Deeper than good or ill will, then, must lie the causes for men's variation of efficiency in the long and the short day. Some common factors must explain it, common to men as widely diverse in capacities and nationalities as the machine-shop workers and miners of Northumberland and Durham and the Thuringian lense grinders and mechanics.

These common factors Abbé found in precisely the two causes to which we have devoted so much attention: the laws governing man's physiologic nature, and the new strain of industry.

We need not repeat here Abbé's admirable physiological analysis. He showed how the vague subjective conception of fatigue and repair rests upon objective measurable metabolic changes within the human body; and he concluded that the workman whose daily deficits, however small, are allowed to stand from day to day, cannot in the end escape bankruptcy.

Some of Abbé's keenest remarks deal with the simplest facts—facts so simple that everyone has always known them, and has lost sight of their significance through very familiarity. But the keen mind can still pluck out the inner significance of words and facts that have become mere "polished

surfaces" of commonplace for the rest of us. Thus Abbé showed how, owing to the minute sub-division of modern labor, the workman incurs a certain amount of perfectly passive fatigue, irrespective of his actual production. The modern worker performs only one repeated operation or the fragment of an operation in the construction of a whole. He sits or stands hour after hour in exactly the same unchanged attitudes, unvaryingly subjected to the same noise, and the same need of attention (to guard himself and others) when he works with moving machinery. These things would be extremely fatiguing, even if no work were to be performed, and in the ten-hour day the workman has to endure daily two hours more of such purely passive fatigue, without thereby accomplishing any more work than in the eight-hour day. It is as unreasonable, says Abbé, as though the employer said to his workmen: "You may finish your work in eight hours, but then you must remain two hours longer, standing or sitting, in the same limited attitudes, hearing the same roar, exerting the same effort of attention, but doing no work."

Moreover, since the metabolic equilibrium is regained only by rest and recuperation, the length of working hours is of critical importance. The rate of recuperation depends clearly upon many variables—age, state of health, state of mind, food, and the like. But the short day gives, at least, the best chances of repair to those parts of the organism most exerted in work, and while after ten hours' work there are but fourteen left for all the other purposes of life, after eight hours' work there are sixteen left.

Finally, as to the greater intensity of work in the shortened day. Abbé explained it also in physiological terms. Good will or ill will does not, in the end, affect the matter. Within certain limits the workman adapts himself automatically to the shortened day by increasing his speed and his effort, without noticeably increasing his exertions, just as one can walk a mile somewhat faster or somewhat slower without appreciable difference. The short workday makes

this closer application possible without injury to the organism, by allowing the worker more time off for tissue repair between working days, and by eliminating so much of the "passive fatigue" which we have discussed above. Every one has a maximum or optimum of production, when he accomplishes most in the shortest time, and the reduction of hours is followed by increased efficiency up to the point where the greater speed and intensity, automatically acquired, overpasses physiological limits. When the worker's natural adaptation to the shorter day is not sufficient, so that pressure and effort must spur him to accomplish too large a task in too short a time, the benefits of reduced hours are lost. For the excessive intensity of effort costs the worker more than is repaired by the longer space of time allowed off for recuperation.

Just where each man's maximum lies, when he can accomplish most in the shortest time without injury to himself, Abbé thought essentially a matter of special investigation. But he concluded, from his own extended observations and from the experience of others in Germany and England, that for about three-fourths of the industrial workers of Germany nine hours was too long a day in which to reach their maximum and eight hours not too short to reach it. He therefore recommended a program still commonly held radical—the gradual reduction of the workday not to nine but to eight hours for German industries, in the interests of economic development and of greater national efficiency.

Abbé made this recommendation before the era of Germany's greatest industrial successes, before the Germans had, as an expert on industrial efficiency writes,* "advanced their industrial condition, which twenty years ago was a jest, to the first place in Europe if not in the world" by realizing "the supreme importance of efficiency as an economic factor." But ten years ago Abbé had a keen eye for Germany's then growing rivalry with British industries, and he foresaw that

* Gantt, H. L.: Work, Wages and Profits, page 179. Published by *The Engineering Magazine*, New York, 1910.

the secret of ultimate success lay in the development of greater national efficiency. Germany's most valuable capital seemed to him the intelligence and initiative of her working people, a buried treasure. And he urged the development of that capital,—the enfranchisement of the capacities of the nation,—by all the resources of science and education. He felt certain that a wiser organization of industry should allow the workers a wider margin of leisure and time for development away from the inevitably deadening monotony of minutely sub-divided labor.

Germany had been spared, he said, the worst consequences of unregulated industrial expansion. The ten-hour agitation in England, preceding and following the bill of 1847, which fixed a normal day for women and children in textile mills and thereby reduced the hours of men in the same mills, kindled a light which had illuminated all Europe (der Widerschein des Lichtes—in England—hat ganz Europa erleuchtet). Abbé himself had seen the reflection of that light in the early 50's. For as a young child, he had seen his father, an old man at thirty-eight, working sixteen hours a day in a Thuringian spinning mill. The British Ten Hours Bill first greeted by employers as the death knell of industry, and as the signal for British capital to migrate to other lands (a fable how often resurrected since that date!) soon showed its true results. German mills, including the one in which Abbé's father worked, soon followed the English precedent and gradually reduced their hours from sixteen to eleven per day.

Thus Abbé knew of his own experience what the shortened day meant to the laborer and his family. He always looked upon industrial problems as a son of the people, as well as an owner and capitalist (mit dem Auge des Arbeitsohnes, dem nicht unter der Hand Unternehmer—und Kapitalistenaugen wachsen wollten).* And his many-sided experience crystallized into a belief that to develop Germany's flesh and blood capital, one of the most important needs was

* Abbé, op. cit., p. 4.

to compress work into as few hours as possible without overstrain or impaired efficiency, so as to widen the ranges of leisure and development.

7. THE TREND TOWARD SHORTER HOURS IN THE UNITED STATES

We have concentrated our attention upon these three examples of reduced hours—English, Belgian and German—because they are specific and are to some degree substantiated by detailed statistics. A host of other less specific examples might be cited from a wide range of industries in which working hours have been successfully shortened without financial disaster. The testimony of employers and manufacturers, showing how efficiency has risen and output flourished when the workday has been reduced to nine and even to eight hours, may be found detailed in various volumes devoted to this topic.* These include industries employing men alone, and industries employing women alone, and those which employ both sexes; industries mechanical, textile, and chemical; trades as diverse as mining and the manufacture of jams; shoe making and ship building; hardware, glass, bottle making and cigar making; printing and the structural trades.

We do not here refer at length to Australasia's half century of success with the short workday. In 1856 the eight-hour day was introduced in the Australian building trades by trade union agreements. Since that time the movement has widened and steadily grown, until now it embraces practically all but the manual workers in clothing and other domestic industries. But a small and distant colony is, as regards trade and commerce, in too isolated a position to be of much practical concern in our discussion. The Aus-

* Some of the best popular books on this subject are: Webb, Sidney, and Cox, H.: The Eight Hours Day. London, W. Scott, 1891. Hadfield and Gibbons: A Shorter Working Day. London, Methuen and Co., 1892. Rae, John: Eight Hours for Work. London, Macmillan and Co., 1894. Weber, Adna T.: The Eight Hours Movement. In Report of the New York Bureau of Labor Statistics, 1900.

tralian industries which affect the world market are chiefly agricultural and stock raising. Hence the Australian eight-hour day has had little significance in world competition. The experience of Australasia in maintaining a workday shorter than the rest of the world is in itself a chapter of deep interest, but we cannot generalize from these facts as we can from facts and figures of a society more nearly akin to our own.

We are, indeed, so largely thrown back upon facts and figures from other countries because our own are the most meager and least satisfactory of any industrial nation. No American studies of output have been published which can compare with the three which we have analyzed above.*

The chief confirmation which our country affords of the point we have been examining in detail,—the effect upon output of the shortened workday,—is the actual movement of industry in the direction of shorter hours, a movement not merely *in posse*, but for some time past *in esse*, existent.

We have already pointed out that during the past thirty-six years there has been a continuous, although very slow, movement towards shorter working hours for women, secured through legislation in their behalf. There has been also a slow but certain march towards shorter hours in men's employments, especially where strong organizations of working men deal collectively with their employers through trade agreements. But here we face an extraordinary paradox! For while working men are bargaining for and obtaining the eight-hour day in many of the great trades throughout the country, women and the laws in their behalf limp in the rear, still for the most part aiming at a ten-hour working day. Eight hours for men, ten hours for women and girls,—an ironic commentary on the cast of our society.

* For an interesting reference to a successful American experiment in reducing the workday see The Steel Workers by John A. Fitch, p. 180. (The Pittsburgh Survey. Russell Sage Foundation Publication. New York, Charities Publication Committee, 1911.) In 1904, the Sharon Steel Hoop Co., at Sharon, Pa., reduced the hours of about 150 men engaged in the finishing mills from ten to eight hours. The tonnage turned out is said to have remained the same, and the general opinion in Sharon was in all ways favorable to the shorter day.

In this instance the discrimination against women is particularly paradoxical, because for many years the only effective reduction of men's hours of work came through the laws reducing women's hours. Men who worked in textile mills with women, shared all the benefits of the long ten-hour agitation in England and America. They were and are automatically dismissed with the women at the close of the ten-hour day. This automatic though tacit inclusion of the men has been recognized since the beginnings of legislation, and at various times the laws for women were most hotly opposed by those who resented that workingmen were obtaining indirectly, "skulking behind the petticoats," a protection which they could not secure openly for themselves.*

Yet in the great trades which during the past twenty-five years have reduced the workday to nine or to eight hours,—such as the cigar makers, the carpenters and builders, the printers, granite cutters and brewers,—few if any women share the benefit.

If the short day were the enemy of production, as its opponents assert, and actually led to a lowered output in the long run, the progress towards an eight-hour day in the great men's trades would long since have broken down. No trade could persist and grow which was permanently carried on at a loss. The trend towards the shortened workday has been retarded by the mistakes of trade unions as well as by the greed of employers; but it is a fact and proceeds today only because, whether recognized or not, it is in harmony with the elemental facts which have emerged from our study; because economic efficiency rises and falls with the worker's physical efficiency, and whatever contributes to the latter tends to raise the former.

The United States Industrial Commission appointed by Congress in 1898, which sat for almost four years hearing evidence from 700 witnesses on capital, labor, agriculture, and immigration, devoted considerable attention in its final

* Webb, Sidney, and Cox, H.: The Eight Hours Day, p. 20.

report* to the economic effects of reducing the workday. It is certain, says the report, that any program for reducing the intensity of exertion must fail.

"The entire tendency of industry is in the direction of an increased exertion. . . . This being true, there is but one alternative if the working population is to be protected in its health and trade longevity, namely, a reduction of the hours of labor."

The commission found that:

"In all cases where reductions have been brought about there have been strenuous objections and alarming predictions, but after a very brief period of trial these objections have disappeared, except where lack of uniformity remains a ground of complaint; and employer and employe, with this exception, alike have agreed upon the advantages of the change." †

The best example of the effects of shorter hours on output deals with bituminous coal mining. A table was compiled from the report of the United States Geological Survey and from the Illinois Commissioners of Labor showing the production of bituminous coal for the six years 1895 to 1900.

The eight-hour day was introduced in the bituminous fields during the latter three months of 1897. From this table we see that, during the two years 1895 and 1896 under the ten-hour system, the average output for the country at large for each working man per day was 2.9 and 2.72 tons; while in 1897, during the latter three months of which the eight-hour day prevailed, the average output per man rose to 3.03 tons per day, and during 1898, 1899, and 1900 (three years of the eight-hour day, in the majority of the coal mines) the average output ranged from 2.98 to 3.09 tons. Each year of the eight-hour day shows for the country as a whole a larger output per day for each workman than the highest output of the ten-hour day.

* Final Report of the Industrial Commission, 1902. Vol. XIX, p. 764.

† Ibid., p. 774.

PRODUCTION OF BITUMINOUS COAL IN THE UNITED STATES, 1895–1900*

Year	Output, Short tons	Average days active	Average number employed	Total days worked	Average output per day, Short tons	Per cent mined by machines
			Country at Large			
1894	118,820,405	171	244,603	41,827,113	2.84	..
1895	135,118,193	194	239,962	46,232,628	2.90	..
1896	137,640,276	192	244,171	46,808,832	2.72	19.17
1897	147,609,985	196	247,817	48,572,132	3.03	16.19
1898	166,592,023	211	255,717	53,956,287	3.09	20.39
1899	193,321,987	234	271,027	63,420,318	3.05	23.00
1900	212,513,912	234	304,975	71,364,150	2.98	25.15
			Ohio			
1894	11,909,856	136	27,105	3,686,280	3.24	..
1895	13,355,806	176	24,644	4,337,344	3.08	..
1896	12,875,202	161	25,500	4,105,500	3.13	26.16
1897	12,196,942	148	26,410	3,908,680	3.12	31.51
1898	14,516,867	169	26,986	4,560,634	3.18	35.76
1899	16,500,270	200	26,038	5,207,600	3.17	41.35
1900	18,988,150	215	27,628	5,940,020	3.19	46.53
			Pennsylvania			
1894	39,912,463	165	75,010	12,376,650	3.22	..
1895	50,217,228	206	71,130	14,652,780	3.43	..
1896	49,557,453	206	72,625	14,960,750	3.31	12.29
1897	54,417,974	205	77,272	15,840,760	3.44	16.40
1898	65,165,133	229	79,611	18,230,919	3.57	25.34
1899	74,150,175	245	82,812	20,288,940	2.66	29.67
1900	79,842,326	242	92,692	22,431,464	3.56	33.65
			Illinois			
1894	16,429,032	183.1	35,398	6,481,527	2.53	..
1895	17,026,429	182.2	35,539	6,475,315	2.63	..
1896	18,995,160	186.0	34,069	6,336,915	3.00	19.57
1897	19,365,847	185.5	31,084	5,766,260	3.36	19.66
1898	17,885,327	174.7	32,223	5,629,518	3.17	18.36
1899	22,497,067	205.7	34,031	7,000,324	3.21	24.90
1900	24,147,771	214.0	36,233	7,753,921	3.11	19.73

The table also shows the increase in the use of machinery in coal mining. But it must not be assumed that the increased use of machinery is responsible for the larger daily

* Op. cit., pp. 770–771.

output of coal for each workman. In one state, Illinois, the proportion of coal mined by machines remained fairly constant; yet, comparing the two years of the ten-hour system, 1895 and 1896, with the three eight-hour years, 1898, 1899, and 1900, it can be seen that the output for each workday has increased considerably. The ten-hour years have an average output per day for each employe of 2.53 to 3 tons; while under the eight-hour system the three years, 1898 to 1900, show an average of 3.11 to 3.21 tons. This, says the report:

". . . must be ascribed solely to the increased energy and promptness of the workman, since, as already stated, the proportion of coal mined by machinery in that state has remained constant. . . . These tables bring statistical evidence to support the testimony of witnesses before the Industrial Commission that in the industry of coal mining the shorter working day has increased the efficiency of both the workmen and the management."

An interesting point brought out by the commission is the incentive to invention and greater economy on the part of the employes under the short-hour system. When working hours are diminished, the loss in time tends to be at least in part compensated, almost automatically, by time and labor saving methods of production, as well as by increased energy on the part of the workers. Doubtless it is true that a good machine often will not run faster in eight hours than in ten hours, but new machines and new devices are continually invented to improve upon the old. As the commission pointedly says:

"While a particular machine will not go faster in eight hours than in ten hours, the substitute for that machine, which the eight-hour day presses upon the employer to adopt, will go faster. Less hours in this way have an indirect as well as a direct compensating effect. Not only do they make it possible for the workman to keep up his intensity of personal exertion during each hour of the day and to work more days at a high rate of speed, but they cause the employer to

economize his labor at every point and to improve its quality by better selection."

Moreover, it must be borne in mind that some of the most useful and time saving inventions and adaptations of machinery have not come from scientific laboratories. They have been invented by American mechanics themselves in the course of their work—work whose intensity was not so great as to destroy all the initiative and nervous vitality which has been in the past associated with the American mechanic and workman. The shortened workday, therefore, in this connection, has a double advantage. On the one hand, it offers a premium on labor saving devices to compensate for the actual curtailment of working time. On the other hand, it preserves in the workman that handiness and mental alertness from which have sprung many of the minor labor saving devices which we like to consider typically American.

The commission concludes that:

"A reduction in hours has never lessened the working people's ability to compete in the markets of the world. States with shorter workdays actually manufacture their product at a lower cost than states with longer workdays."

Conceivably, hours might be reduced to the point where increased cost of production would over-balance the gains to health and efficiency. On this point the commission holds:

"If it were a question of reducing hours to absurdly low limits, nothing could be said in favor of the movement; but where—as is actually the case—the goal set up by the working people is the eight-hour day, and there is no proposition and no way for a five- or a six-hour day, the arguments for reduction need no qualification from the standpoint of the workers and little from that of employers."*

One final point needs to be considered in connection with the output of the shortened day; that is, the effect of regula-

* Op. cit., p. 773.

tion upon wages. Upon this point little can be dogmatically asserted. When we consider the rise and fall of wages in a large sense, and throughout a long period, a great variety of factors intervene. The causes of business depression and business prosperity are themselves obscure and often arise from sources incredibly remote and fantastic. Drought, poor crops, pestilence, wars—both of arms and men, or of tariffs—often the mere fear of these, and things less tangible, such as "loss of confidence," set the solid business world, like a flimsy fabric, aquiver; a sentiment can again quiet it. With such extreme instability of values, wages are naturally bound up; cuts or increases respond to the business fluctuations, and it would be idle to ascribe the fall and rise of wages to one isolated phenomenon, such as the limitation of working hours.

And yet, amid this flux of things, two uncontroverted facts stand out clearly: first, that the best wages are paid in the most strictly regulated trades. Where the limitation of hours is most defined and best enforced, wages are invariably highest. The unregulated trades, with the longest hours, are the most sweated and underpaid. Second, while we cannot assert that the operation of factory laws has been the direct cause of higher wages, there is no doubt that the sequel of shorter hours has almost invariably been a rise in wages, even after a temporary loss.* Output, as we have seen, has been maintained and increased in the shortened hours. The main cause for this has been the increased efficiency of the workers, and this is the explanation also of the seeming paradox of twelve hours' pay for ten hours' work, and ten hours' pay for eight hours' work.

* See Part II of this volume, pp. 395–407.

VI

REGULARITY OF EMPLOYMENT: FATIGUE AND OVERTIME WORK

1. OVERTIME AS A SEPARATE ISSUE

THE discussion of overtime is something to be sharply differentiated from the general question of reducing the length of the workday. It is true that when overtime is added to the day's work, making it nine to twelve hours or longer as the case may be, all the arguments that apply against the long day apply against overtime as well. It is bad because it results in too *long* a stretch of working hours, with all that implies for subject and object, worker and work.

How, indeed, could it be otherwise? For whether the last exhausting hours of the day be called "overtime," or are a regular part of the day's work, the practical results of such protracted hours must be the same.

But overtime means something more than an over-long period of work. It means irregular work; it means evening work after and in addition to day work, often without previous notice to the employe; it means in many trades that worst sequence, overwork followed by out-of-work, a "rush" season of too much work with the slack season of no work and destitution close behind it. Hence in discussing overtime, besides the evident injuries to health and output, a number of other fundamental points need to be taken into account and realized. Is overtime inevitable and uncontrollable? How can it be replaced or avoided? This discussion is the more important because the really large issues involved in overtime, seemingly so subordinate and technical a question, are, as we have pointed out, so often totally misunderstood

or ignored. These large issues we will attempt to outline under two heads: first, the relation between overtime and greater continuity or regularity of employment; and second (in Chapter VIII), the relation between overtime and the crux of all legislation, enforcement.

First, however, as to the evident likenesses between overtime and the long day in general. On the physiological side, we have seen that overtime, like other forms of overwork, injures health because, in one word, it strains. It postpones rest beyond the point when rest can normally accomplish its office of repair. "Too late," is nature's answer to the slack period or let-up after an overtime bout in factory or store, and grievous are nature's revenges for the postponement of our metabolic debts. Through the overstrain of that mysterious agency which, as we have seen, "directs, controls, and harmonizes the work of the parts of the organic machine"—our ramified nervous system—any or every organ may retain the semblance of perfect health and may yet refuse to function. Nervous dyspepsia, nervous palpitation of the heart, nervous eyestrain, and such functional ills are well recognized products of some form of "over-doing," as we call it among the well-to-do. Among working people, the same disorders and their causes have, in this country, received scant notice. These are what overtime work invites and brings with it, requiring during over-long hours increasing stimuli for wearied muscles from already tired nerve centers.

On the economic side, too, overtime work, like all overwork, results in deteriorated quantity and quality of output. In the long run, the enlightened employer is obliged to conclude that overtime does not pay. To this day, "spoiled work" is as marked a result of overtime as it was of the late working hours famous in the first English struggles for legislation.*

Such an occupation as dressmaking illustrates the deterioration due to overtime work. Here the caprice and in-

* See Part II of this volume, pp. 433–440.

considerateness of customers have been in large part responsible for the universally outrageous duration of overtime, which is common in the creation of women's wearing apparel in every country. Year after year, the French and British factory inspectors have enlarged on the essentially wasteful, uneconomical character of overtime in destroying the efficiency of the workers. After a comparatively short period of pressure, output not only becomes inferior, but progressively so. Each week's work bids fair to be progressively poorer than that of the previous week.

Another reason why output falls off during overtime is due to the irregular habits which it fosters. It is hardly surprising that workers should come to work late the next morning after evening overtime, and that the reaction after a spurt should lead to "loafing" and inferior production in consequence.*

2. OVERTIME AND REGULARITY

So much for the evident similarity of results, physical and economic, between overtime and the long day. We turn next to the distinctive characteristic of overtime, its irregularity and the supposed necessity for longer working hours at certain times or seasons of the year. Indeed, in a certain sense, overtime is a survival of the long day, a stray left over from the time when any legislative regulation of working hours was considered intolerable. First, men held that the working day could not be regulated at all without financial disaster. Then, when it was shortened, and industry still throve, the same kind of argument insisted, and still insists, that the law must allow concessions, privileges for certain occupations which, according to the employers, can not be compressed within the specified limit of hours.

The provision for overtime work proceeds on the theory that at certain times and seasons employers cannot manage or meet their obligations under their regular schedule of

* See Part II, pp. 440–444.

hours, but must be free to call upon their employes for extra work. This theory has obtained in almost every industrial country that has restricted the hours of labor by law: the regulation of overtime has been one of the most vexed chapters.

In innumerable trades it has been assumed that the demands of customers, reasonable or unreasonable, and the necessities of the season, avoidable or not, can be met in no other way than by lengthening the day's work for a longer or shorter period of time.

3. EFFORTS TO EQUALIZE SEASONS

But to lengthen the day's work is in fact not the last word on the subject. In many industries the most enlightened employers have found that overtime work is essentially inefficient, that excessive irregularities in work are as demoralizing to business as they are physically damaging to the workers. It has proved possible to replace overtime, in large part, by spreading work more uniformly over the entire year, instead of concentrating it into short periods of intense overwork. Untold effort and money have been spent to equalize more nearly the week's and month's business. Thus, for instance, the now prevalent January "white sale" of the department stores was devised some years ago by a prominent New England firm, to attract customers during the stagnant period after the Christmas "rush." It was not written in the eternal fitness of things that the purchase of new linens should be associated with the first month of the year. But such is the psychological force of advertising, that the shopping public has become educated up to the January "white sale" throughout the country, and now no well-conducted store is without an artistic display of damasks, table linen, bed linen, and women's white underwear, as soon as the new year opens. When the heavy spring trade starts later in the year, the sale of white goods is, for the most part, over. Indeed, this effort to equalize seasons has been carried to such

lengths that the January "white sale," invented as a stop-gap between seasons, has itself become a "rush" period.

This example is only one of many such efforts which might be cited. It has been found profitable by merchants to make the week's as well as the month's business approximately equal. In many cities, the custom of making Monday a day of special "bargains" and "green trading stamps" has likewise been implanted in the public mind, for the sake of attracting customers on a previously dull day, and more nearly equalizing the business of the week.

But the more important and more radical movements of this order have been carried out in manufacture rather than in commerce. The most farsighted manufacturers have shown how work can be more uniformly spread over the entire year, instead of allowing it to be crowded into short "rush" periods followed by stagnation.

By way of concrete illustration, the reorganization of two great New England establishments, for the precise purpose of more nearly equalizing seasons, may be briefly described.

The first of these is one of the largest shoe factories in the United States. The shoe trade was, and in many instances still is, a seasonal industry. Manufacturers wait for the spring and fall orders, slack periods alternating with seasonal rushes of work. The firm in question decided that this system was too great a strain upon their equipment; that it was wasteful and unnecessary. They determined to continue at work during the slack season by opening up new lines, requiring customers to send in their orders earlier, and by similar devices. Customers were notified that in order to have orders filled they must be received by certain fixed dates. Once received, the order is like a promissory note which will be met by the manufacturer at the given time. The dates for receiving and delivering orders are fixed in rotation, arranged so that each month's work is approximately equal. The scheme has been worked out in minutest detail, and since it has been put into practice this establishment has completely abolished overtime, as well as a slack season.

Uniform, continuous work has not only relieved the alternations of idleness and overwork; it has, financially, paid.

Similar has been the experience of one of the important manufacturers of jewelry cases in the United States. Case and box making is likewise a seasonal trade. The plethora of boxes needed for the Christmas trade—fine jewelry cases, candy boxes, boxes of innumerable shapes, sizes, and qualities—is usually not ordered by retailers until late in the year. A congestion of work results for the box makers in October and November. The manufacturer of cases whom we are considering and who supplies a large proportion of the fine jewelry cases used in the East, decided likewise, a few years ago, to equalize his year more nearly if possible. He, also, reorganized his business for the sake of obtaining that regularity of work which, once established, benefits employer and customer as much as employe. He has, indeed, met with so successful a response from his customers, that their orders are projected months in advance, being given sometimes as early as January for the following Christmas.

4. THE ADAPTATION OF CUSTOMERS

These examples of successful attempts to equalize seasons for purely business reasons illustrate also how the public adapts itself to changes of habit in purchasing. We are too apt to look upon custom, use and wont, *what is*, as entirely static things, impervious to change. In fact, however, habits are not as tyrannical or clod-like as they appear, and in communities as well as in individuals the power of new ideas works its astounding transformations.

The possibility of altering a well-entrenched habit on the part of the public was interestingly illustrated in Illinois a few years ago, when the passage of the ten-hour law for women prohibited overtime in laundries. Laundries have always required from their employes longer and more injurious overtime than perhaps any other industrial establishments in which women are employed. The schedule of

working hours in laundries is very irregular. Not only in the United States but also in Great Britain and in Germany the long and irregular day's work in laundries has been repeatedly investigated and found unmistakably dangerous to health. The scrupulous cleanliness and abundance of clean linen on which our generation prides itself has been dearly provided, unknown to the wearers.

Work in laundries usually begins late on Mondays, is slack on Saturdays, and on the remaining days of the week runs up to a wholly indefensible number of hours. Women have been found employed in laundries as much as seventeen consecutive hours.* The alleged necessity for this overwork has been the need of completing large orders from restaurants, steamship companies, and barber shops, as well as private families, in the quickest possible time. When the Illinois ten-hour law for women in factories and laundries went into effect in 1909, notices were posted by certain large steam laundries in various public places announcing that, on account of the new law, they would not be able to deliver laundry work on any Saturday unless it were received by the previous Wednesday noon. Previously linen had been accepted as late as Friday for delivery on the following day. Such a stand as the laundries assumed towards their customers doubtless means that the establishments which have previously insisted upon the almost immediate return of their linen will be obliged to lay in a larger stock. Nor does there appear to be any legitimate reason why the difficulty should not be met in this way, rather than by the indefensible overwork of thousands of girls and women in the hot and exhausting laundry occupations.

The recorded experience of the British factory inspectors during the past twenty years in enforcing the law (in the textile and other well-organized trades where overtime is prohibited) shows unmistakably how the demands of customers yield to the requirements of a fixed legal working day. When

* Report of the Consumers' League of the City of New York for the year 1909, p. 24. Published March, 1910.

customers are obliged to place orders sufficiently in advance to enable them to be filled without overtime work, this habit soon tends to become automatic.*

5. THE POLICY OF PERSUASION BY CONSUMERS

The experience of the laundries shows not only how customers adapt themselves to necessity and the requirements of a fixed rule, but how the prohibition of overtime tends to create a greater regularity and uniformity of hours. Before the passage of the law of 1909, the Illinois laundry owners had presumably not considered the possibility of abolishing overtime and had certainly not attempted to require a more reasonable margin of time for delivery.

Since the beginning of modern industry, a vicious circle has tended to exist between the customer's (wholesale or retail) habit of waiting until the last minute before giving orders, and the employer's acceptance of orders at such late dates, regardless of the cost to his personnel and equipment. Either party could forcibly break this circle if either would take a determined stand—the customer by giving orders in time and refusing to accept them unless finished in season; the employer on his side refusing to accept orders received too late. Neither customers nor employers, however, are apt to take the initiative in this way until really urgent need arises.

But when an outside authority—the law—representing the sentiment of the whole community, limits the length of the workday, both employers and customers are protected—the former against unreasonable requirements of their clientèle, the latter against wearing, eating, or otherwise consuming articles the manner of whose manufacture or sale they condemn.

It is true that consumers have in their own hands a considerable power of demanding changes from the manufacturers and merchants with whom they deal. It is plainly

*See Part II of this volume, pp. 407–411; 528–531.

to the latter's advantage to meet the desires, even the whims of their patrons; yet the consumer's power of obtaining what commodities he desires, in an infinite variety, has been little used to secure working conditions of which he can thoroughly approve for the workers by whom he is clothed, fed, and otherwise provided with the material equipments of life. Even when the consumer awakes to a desire to mend conditions, the method of securing improvements from employers as favors, is sharply differentiated from the method of legislation, which secures them as rights.

So, for instance, at Christmas time it has long been supposed that the employment of thousands, even hundreds of thousands, of young women is unavoidable each evening in the large cities, to wait upon a throng of shoppers and sightseers. So firmly fixed in the public mind has this belief been that in New York state, for example, the law which protects young women between sixteen and twenty-one years in stores, from more than sixty hours' work in one week, is suspended during the Christmas "rush," when most needed.

During the past twenty-one years an association of customers or consumers in New York City has consecutively endeavored to persuade the merchants with whom they deal to close their establishments in the evenings during the last half of December, in default of a law prohibiting Christmas overtime.* This policy of persuasion has led a growing number of the best establishments to close early, without financial disaster.† It proved that the supposed necessity of keeping these young women clerks at work in the evening after an exhausting day's work, is after all not inherent. For when customers are not able to postpone their shopping for gifts until a few nights before Christmas, they find it possible, for the most part, to attend to it between eight in the morning

* Reports of the Consumers' League of the City of New York, 1891 to 1911.

† In 1911, from among 40 of the best known stores in New York City all but 14 closed at 6 or 7 o'clock in the evening. Only four stores remained open more than three nights before Christmas.

and six at night. But the time and effort required to prove this has been out of proportion to the results attained; it has shown likewise that the early closing movement to be successful, must be sustained by a specific law.

6. THE LEGAL PROHIBITION OF OVERTIME

Hence the Consumers' Leagues, which under a national organization have spread into 17 different states, are devoting their efforts more and more to securing specific laws for the protection of working women and children. Justice and expediency demand that a uniform rule shall protect the progressive and check the backward employers in stores and other commercial establishments as well as in manufacture. Wherever the indiscriminately long seasonal employment of women has been forbidden by law, even the backward employers have found it possible to mend such irregularities, in some degree if not wholly, by foresight and management. A more equal and uniform distribution of work throughout the year has followed. This seems to be the uniform experience of countries whose industrial experience is recorded in the reports of their factory inspectors. British, French, German reports coincide in yearly comments* that legislation which fixes a "normal day" has been the best incentive towards greater regularity of employment, planned in advance to meet the legal requirement as to hours. In 1902, and again in 1903, the Committee of the British Association for the Advancement of Science, appointed to investigate the economic effect of legislation regulating women's labor, took occasion to emphasize the influence of legislation on regularity of employment, stating that the British acts had led to spreading work more uniformly over the week, month, and year, and that without the acts it "seems certain" that there would have been less uniformity.†

* See Part II of this volume, pp. 444–463.

† British Association for the Advancement of Science, 1902. Women's Labour, 2nd Report, pp. 293–295; 1903, 3rd Report, pp. 340–341.

On the other hand, in trades where overtime has been tolerated, the pressure towards long and irregular hours—"spurting"—has been almost irresistible. As one of the British inspectors somewhat naïvely puts it:

"I am afraid that foresight and arrangement will never be exercised while the mischievous expedient of overtime is made so easy."*

It is indeed so much easier, so much more in line with natural human inertia, simply to lengthen the workday by a few hours, and to keep the workers who are on hand, rather than to plan laboriously in advance to meet emergencies, that overtime takes on the appearance of an absolute necessity.

No industry illustrates this more clearly than the canning trade, to whose quite unrecognized physical hardships we have drawn attention in a previous chapter. In few industries, on the whole, have employers made less consistent efforts to reduce overtime. At the same time they are insisting to legislatures and the public that overtime work is an inherent necessity in the canneries.

In the federal investigation, as we have seen, women were found employed in the canneries up to ninety hours in the week, while the canners maintain that without such intolerable exploitation their industry could not exist, when a seasonal glut of raw materials overtakes them. But the truth is that there are more than two horns to this dilemma. For while the canners are so depleting their workers, on the plea of unavoidable necessity, they are at the same time often found neglecting the most elementary means of meeting the admitted difficulties of their industry, and of providing themselves with a sufficient number of workers at times of glut. In the summer of 1907, as was known to the writer, some women were employed in one New York cannery up to eighty-five hours in one week, while side by side with them other women were employed twenty-five hours and less. At some canneries no devices more effective than ringing the

* British Sessional Papers. Vol. XVII, p. 90. 1893.

factory bell were used to summon workers living within hearing distance, when unexpectedly heavy pea deliveries were received late in the afternoon, and workers who responded to the summons were kept working until after midnight—sufficient proof that the canners have simply rested upon their alleged "necessity" for overtime, and have spent upon the organization of the working force little of the ingenuity and intelligence which have been devoted to the technique of canning. It is not credible that in a trade where technical mechanical processes have been brought to such perfection, the difficulties of management can not be better solved.

The latest government investigation of canneries in Maryland and California, dwells upon this "entire absence of working-time records, and almost uniform lack of records of any description for the piece-workers."*

"Without such records," as the report says, "it is impossible for employers to make any progress in distributing the strain of excess work over the whole force, for there is nothing but the memory or personal interest of the foremen to mark the working time of each employe. . . .

"It is singular that employers who direct other phases of their business along lines indicated by carefully kept accounts should attempt to regulate the supply of so large a part of their labor without the help of adequate records."†

Indeed, once overtime is tolerated on the plea of necessity, it is almost impossible to draw the line where necessity

* Bulletin of the United States Bureau of Labor, No. 96, Sept., 1911. Hours and Earnings of Women Workers in Maryland and California, pp. 399–400.

† Interesting confirmation of this disorganization of the labor force was given at the public hearing on the ten-hour bill for women, at Annapolis, Maryland, on February 14, 1912.

"Mr. Soper (counsel for the canners): No record is kept of the names of these people, is there?

Mr. Numsen (a canner): Absolutely none.

Mr. Soper: If you were to go to the canners and ask some of them to show you their books, they cannot show, to save their souls, how many hours any particular person worked in their factory; not because they want to conceal it, but because of the exigency of the situation which does not permit of the record; therefore, nobody can tell exactly the amount of time that is put in by any particular person." (Stenographic record of hearing, pp. 27 and 40.)

begins and ends. The canners maintain that overtime is unavoidable on account of the perishable nature of their raw produce. But what possible defense is the perishability of fruits and vegetables for such a common practice as the employment of women at night at labeling jars and cans?

The federal report on canneries states that in California some of the "long drives,"—reaching a maximum of twelve to fifteen hours a day or seventy-two to ninety-eight hours in one week,—are worked by labelers and stampers, who handle the product "after it is canned, hermetically sealed, cooked, and no longer perishable."*

What justification is the perishability of the products for requiring overtime work at making fruit and berry baskets? Fruits and berries are perishable, but no perversity could so describe the baskets. Yet in one state at least (Delaware) the canners have actually had enacted into law special permission to work young children of any age, for any number of hours, at berry and fruit basket making, as well as at the technical processes of canning. Anyone can see that there is no shadow of excuse for such exploitation. It is due to the sheer license which flourishes in such employment as the canneries and the sweated trades, where the employer is free to use his employes to the limits of their physical strength.

It is indeed true that far greater difficulties attend a regular schedule of hours in the canneries than in other factories. Once a glut of produce reaches the canneries it must be used at once, within a very short period. Experts allow five to twenty-four hours for holding peas before canning, about twenty-four hours for beans, and so on,† though the possibilities of cold storage have not yet been explored. The canners cannot stay the hand of Nature or prevent the sudden ripening of crops. But they can learn and provide in advance for these alleged "emergencies" to an extent quite unapproached at present in most states.

* Bulletin of the United States Bureau of Labor, No. 96, p. 395.

† Annual Report of the Bureau of Factory Inspection. New York State Department of Labor, 1908, pp. 393, 394.

It was on this ground that the Supreme Court of Massachusetts, a few years ago, refused to accept the plea of necessity for violation of the Sunday law by the owner of cranberry bogs in Plymouth County.* The court's decision is so clear and goes so directly to the root of the difficulties in limiting the day's work as well as in enforcing the Sunday rest that it should, at least in part, be quoted.

The owner of the bogs contended that he could not harvest his crop without working on Sunday; that Sunday work was not unlawful, if it was a matter of necessity; and that he was justified in working on Sunday if, "owing to the size of the crop, the difficulty of procuring or housing labor, the prospect of frost, or the danger of the fruit getting overripe and other circumstances, he had reason to believe that the crop might be injured or lost if he did not gather it on the Lord's Day."

On cross examination in the lower court, it was shown that if the employer had procured enough men—only one-sixth more—"he could have done the same work in six days that he was doing in seven." It was also shown that while the crop was three times greater than it had ever been before, the owner knew at the end of July that he should probably have such a crop and that he should have to employ a great many more men to take care of it in September. It was shown that his employes lived in shanties owned by him, that he could not accommodate any more men, and had not made any effort to do so. He began to employ between three and four hundred men towards the middle of September.

The judge in the lower court instructed the jury that the employment of these men on Sunday was not, under the circumstances, "work of necessity within the meaning of the statute." In upholding the decision of the lower court, the Supreme Court of Massachusetts further emphasized the fact that this work was not one of necessity, and refused to consider as emergencies, facts which might have been provided for in advance.

* Commonwealth v. Edwin M. White. 190 Mass. 578.

"Without going over the evidence in detail," said the court, "it is sufficient to say that here there was no extraordinary, sudden and unexpected emergency. The crop was large, it is true, but that it was likely to be large had been known for weeks. The weather was only what might have been expected. The substance of the testimony was simply that in gathering the crop it was somewhat less expensive and more convenient to work seven days in the week rather than six. That is not enough. Such testimony falls far short of showing 'necessity' within the meaning of the statute."

After all, these so-called "emergencies" in the canneries are essentially the same (although of far higher degree) as those which may arise in all businesses. With the fickleness of modern fashions, and their extraordinarily sudden changes, the market for most commodities is precarious. All the articles of men's as well as women's clothing—garments, hat-wear, foot-wear, ornaments, jewelry, the furniture of our houses, the service upon our tables, sports (like bicycling, a few years ago, and motoring today), the very songs of the music halls, echoing in the streets and in the innumerable musical instruments whose manufacture develops from year to year—all these things are subject to changes in fashion more violent than a former generation could dream of. Articles in demand in January are out-of-date by June. Last year's models are antiquated. The whirligig of time never before brought such revenges. And in consequence all these commodities are practically "seasonal," in the sense that they are of value at a given moment or season, like fruits, berries, and vegetables ripe in field or orchard. And like the fruits, too, after their moments of prime, they are useless, over-ripe.

Are we then driven to conclude that all these manufactures must have special concessions and privileges of overtime allowed by law, such as the canners maintain that they must have? No. In this country we have, with single exceptions, recorded in our legislation (and are now facing the problem of enforcing) our contention that, so far as

working women and children are affected, the seasonal necessities must be provided for by good management within reasonable working hours; that, in a word, production must be limited to conserve the workers' health and welfare, which is the health and welfare of the nation.

That such a contention is not unreasonable the best practice in all industries tends to prove. The appeal is always from Philip drunk to Philip sober: from the alleged impossibilities to the actual facts. Even in canning, the extent of overtime varies greatly in different establishments, and this variation, as a recent New York labor report points out,

"is of itself highly significant. For if one firm has very little overtime while another has a great deal, . . . the question naturally arises whether the overtime actually occurring in the latter is not due to the methods of management of that firm, rather than to conditions necessarily inherent in the industry.

"Positively it can be said that the very fact that some firms get along with little or no overtime, seems to throw upon those with more overtime the burden of proving the necessity for such overtime."*

Overproduction,—the attempt of manufacturers to contract for more than their equipment can legitimately accomplish,—is well known the world over, and, as a policy, defeats its own ends. It is like unintelligent farming, which tries to get from the soil more than it can bear, and leaves it impoverished after too abundant bearing. The soil, in time, can be revivified, if nourished and allowed to lie fallow. But after over-production, what working people can afford to lie fallow, even were the revival of their powers thereby assured? As the British factory inspector, already quoted, intelligently remarks:

"There will always be some people who do not know how to refuse orders, however little they may be prepared to execute them, and who expect their work people to help them out of the difficulty by working excessive hours."

* Annual Report of the Bureau of Factory Inspection. New York State Department of Labor, 1908, p. 363.

It is precisely to save workingwomen from the dilemma of either working such excessive hours, or of suffering dismissal, that the police power of states has interfered with "private" businesses and has sanctioned legislation which regulates the length of the workday. That legislation is still most defective in tacitly or specifically allowing overtime.

Our conclusion would, therefore, be that the alleged necessity for overtime, and the consequent irregularity of work, is not an inherent necessity. If the testimony of experience counts for anything, it goes to prove that in fields where overtime and irregularity were long thought indispensable, a better organization has spread work more uniformly through the year, and has in large part done away with overtime. It shows also that the caprice of customers, to which the necessity for overtime is often ascribed, can also be regulated to a degree as yet unapproached in many industries. Finally, both for customers and employers, the best incentive to regularity has been the legal regulation of working hours—a regulation which is most effective where it is most specific and exact.

VII

THE NEW SCIENCE OF MANAGEMENT: ITS RELATION TO HUMAN ENERGIES

IN the preceding chapter, the detailed planning of output in advance of performance, in two progressive New England establishments, was related to point out the permanence of employment and avoidance of overtime thereby effected.*

These results or, more truly, by-products were achieved by means of the new system which, under the name of scientific management, industrial efficiency, and the like, is slowly spreading through the world. We have already touched in passing upon several incidents of this new order, such as the increased use of the stop-watch in gauging men's efficiencies. Abbé's studies of individual working capacity also tended in the direction of scientific management. But the system itself is something immensely larger than any of the factors which compose it. It is a philosophy, not a new routine; or more exactly, it is a new synthesis of many elements previously tested and untested. Its results have intoxicated the imagination. "I cannot prophesy the end, there is no end. . . . I am learning my trades all over again," testified a prominent contractor in regard to the system, before the Interstate Commerce Commission.† Scientific management is said to differ from the ordinary systems of production "much as production by machinery differs from production by hand; and the revolution . . . which must result from the introduction of scientific management is com-

* See pages 178–179.

† Brandeis, Louis D.: Before the Interstate Commerce Commission, Docket No. 3400. Brief on behalf of the Traffic Committee of Commercial Organizations of Atlantic Seaboard, 1911, pp. 21 and 33.

parable only to that involved in the transition from hand to machine production."

These are prodigious assertions seriously made. Of the philosophy and practice which underlie them we can consider here only the most distinctive notes, which are most closely allied to the subjects which we have treated up to this point.

1. DIFFERENCES BETWEEN ORDINARY SPEEDING-UP AND THE NEW SYSTEM

Some concrete examples of increased efficiency under scientific management are as follows:

> "(a) When applied to the simple operation of loading by hand a railroad car with pig iron, the performance of the individual worker increased from 12½ to 47 tons a day.
>
> "(b) When applied to shoveling coal, it doubled or trebled the performance of the shoveler.
>
> "(c) When applied to machine shop work, it developed in certain operations increases in production, ranging from 400 to 1800 per cent.
>
> "(d) When applied to bricklaying, the day's accomplishment rose from 1000 to 2700 bricks. (Gilbreth: Record, p. 3410.)
>
> "(e) When applied in the manufacture of machinery, 75 men in the machine shop with 20 in the planning department do two to three times as much work as 105 men in the machine shop did under the old methods. (Hathaway: Record, p. 3059.)
>
> "(f) When applied in the manufacture of cotton goods, it increased the output 100 per cent. (Scheel: Record, p. 3377.)"*

"One of the folders on light work (in a cloth finishing establishment), a wonderfully skilful young woman, who had folded 155 pieces a day before, now folded 887."†

* Brandeis, op. cit., pp. 38–39.

† See Scientific Management as Applied to Women's Work, in Clark, S. A., and Wyatt, Edith: Making Both Ends Meet, p. 242. New York, The Macmillan Co., 1911.

The question at once arises: How do these extraordinary increases of output differ from the ordinary speeding up and pace-making which we have seen to be common in industry, and prime factors in its overstrain? It is entirely natural that, at first sight, the almost incredible heightening of human capacity which scientific management achieves should be viewed with extreme suspicion. Instinctively we ask how this is accomplished, and what are its effects upon the workers.

In both ordinary management and under the new system, it is the stimulus of reward which calls forth the extra exertions of the workers. Indeed, scientific management has evolved stimuli of far greater psychological power than any known before, in its finely adjusted rates and proportions of pay.

But the diversified pay systems are merely subordinate mechanisms. Scientific management differs from other systems not in degree, but in kind. Ordinary management leaves the workers in any industry to learn and pursue their trades by imitation from their fellows, by tradition and the rule of thumb. Scientific management assumes the responsibility of teaching the workman a predetermined task and keeping him adequately provided to accomplish this task.

In this apparently simple assumption lie the germs of a wholly new system of production. The responsibilities assumed by scientific management involve a new conception of every business. It replaces empiricism by predetermination of results; the haphazard of the mechanic by the engineer's application of scientific laws. Each process of work is analyzed into its ultimate units. Each smallest step of the process is compared with an ideal standard of performance, and allowance being made for practical conditions, an attainable commercial standard is set for each unit of work and for the whole work reassembled in its entirety.*

This brief formula contains the gist of a long series of complicated operations. It presupposes the scientific selection of workmen for their tasks; an analytical time study of

* Brandeis, op. cit., p. 17.

each unit of work; records of the accomplishment of not only each individual but of each machine and of the material used; the standardizing of all tools, machines, and equipment, and similar contrivances for obtaining in advance exact knowledge of "what work is to be done, how it shall be done, when it shall be done, and what it shall cost." Some concrete examples will make this clearer.

Let us consider first one which has been most widely quoted and which deals with one of the simplest forms of human labor,—loading a freight car. Frederick W. Taylor,—best known in the scientific world as the author of the "Art of Cutting Metals," a profound work resulting from twenty-six years of investigation,—is also the originator of the new study of efficiency. He has given an intensely interesting account of the first application of the new system at the Bethlehem Steel Works.*

"The opening of the Spanish War found some 80,000 tons of pig iron placed in small piles in an open field adjoining the works. Prices for pig iron had been so low that it could not be sold at a profit, and it therefore had been stored. With the opening of the Spanish War, the price of pig iron rose, and this large accumulation of iron was sold. This gave us a good opportunity to show the workmen, as well as the owners and managers of the works, on a fairly large scale the advantages of task work over the old-fashioned day work and piece work, in doing a very elementary class of work.

"The Bethlehem Steel Company had had five blast furnaces the product of which had been handled by a pig-iron gang for many years. This gang, at this time, consisted of about 75 men. They were good, average pig-iron handlers, were under an excellent foreman who himself had been a pig-iron handler, and the work was done, on the whole, about as fast and as cheaply as it was anywhere else at that time.

"A railroad switch was run out into the field, right along the edge of the piles of pig iron. An inclined plank was placed against the side of a car, and each man picked up from his pile a pig of iron weighing about 92 pounds, walked up the inclined plank and dropped it on the end of the car.

* Taylor, Frederick W.: Principles of Scientific Management, pp. 41 and 42. New York, Harper and Brothers, 1911.

"We found that this gang were loading on the average about 12½ long tons per man per day. We were surprised to find, after studying the matter, that a first-class pig-iron handler ought to handle between 47 and 48 long tons per day, instead of 12½ tons. This task seemed to us so very large that we were obliged to go over our work several times before we were absolutely sure that we were right."

How, now, had this result been come at? Mr. Taylor had long sought to discover, and had spent years in attempting to measure "the tiring effects of heavy labor" upon a first-class man. His object was to find an exact mechanical measurement of daily work. He sought to learn what fraction of a horse-power a man was able to exert in one day, translated into foot pounds of work.* Records of previous experiments by physiologists and engineers were found too meager to base any laws upon. Accordingly, in 1881, while Mr. Taylor was employed in the Midvale Steel Works, he began the series of experiments which ultimately yielded the desired result and led the way for the system which bears his name.

Two first-class laborers were selected and were given various tasks. Each motion was timed by a stop-watch. Useless and awkward motions were eliminated or replaced by correct movements. But no relation was discovered between the tiring effects of various kinds of heavy work and the foot pounds of energy exerted.

"On some kinds of work the man would be tired out when doing perhaps not more than one-eighth of a horse-power, while in others he would be tired to no greater extent by doing half a horse-power of work. We failed, therefore, to find any law which was an accurate guide to the maximum day's work for a first-class workman."†

It was not until some years later, after a second and third elaborate series of observations and measurements, that

* One foot-pound = the amount of energy required to raise one pound to a height of one foot. One horse-power = 33,000 foot-pounds per minute.

† Taylor, op. cit., p. 55.

the law sought was found. "And it is so simple in its nature," says Mr. Taylor, "that it is truly remarkable that it should not have been discovered and clearly understood years before." From our physiological point of view, it is peculiarly interesting to find this law of mechanical work simply an extension and mathematical working out of the basic principle which has emerged from our study of fatigue: *That rest must adequately balance exertion.* Translated into the language of mechanical labor, this requires that a man should be under load for only a definite percentage of the day, and must be entirely free from load at frequent intervals.

"For example, when pig iron is being handled (each pig weighing 92 pounds), a first-class workman can only be under load 43 per cent of the day. He must be entirely free from load during 57 per cent of the day. And as the load becomes lighter, the percentage of the day under which the man can remain under load increases. So that, if the workman is handling half-pig, weighing 46 pounds, he can then be under load 58 per cent of the day, and only has to rest during 42 per cent."*

The process of adjustment is continuous, and as the load grows lighter the workman can remain under load, without undue fatigue, during a larger and larger percentage of the day.

This formula was obtained by Mr. C. G. Barth's mathematical studies, in which each element of the work was graphically represented by plotting curves, to give a bird's-eye view of the data and records accumulated.

But to explain the formula thus evolved, we must revert again to the familiar language and conceptions of physiology. As Mr. Taylor puts it:

"Throughout the time that the man is under a heavy load, the tissues of his arm muscles are in process of degeneration, and frequent periods of rest are required in order that the blood may have a chance to restore these tissues to their normal condition."†

* Taylor, op. cit., pp. 57 and 58.

† Ibid., p. 58.

No constant relation was found between the foot pounds of energy exerted and the tiring effect of various kinds of heavy muscular work, because no horse-power whatever is exerted by the man who stands still under load, however intense his efforts. His arm muscles are under the same severe tension whether he is moving or not, but that tension had not been registered.

Such were the results of the long-continued observations and studies which preceded the efficiency engineer's estimate of 47 long tons instead of 12½, as the proper day's work for pig-iron handlers. His practical task was now to select workmen specially fitted for this type of work; his next to train them to accomplish it. Mr. Taylor's account of this process in relation to the new management is again of intense interest:

"Schmidt started to work, and all day long and at regular intervals, was told by the man who stood over him with a watch, 'Now, pick up a pig and walk. Now sit down and rest. Now walk—now rest,' etc. He worked when he was told to work, and rested when he was told to rest, and at half past five in the afternoon had his 47½ tons loaded on the car. And he practically never failed to work at this pace and do the task that was set him during the three years that the writer was at Bethlehem."*

Gradually other men were chosen and trained to handle pig iron at the rate of 47½ tons per day, receiving $1.85 instead of the ruling rate of $1.15 per day, until all of the pig iron was handled at this high rate and the gang received 60 per cent higher wages than other workmen around them.

In this instance it is perfectly clear that such an extraordinary heightening of human working capacity could not possibly have resulted from the mere incentive of a high wage. It resulted from the application of the laws of exact science learned after years of investigation. The high wage was nothing more than an inducement for the workman to change

* Taylor, op. cit., p. 47.

his ordinary habits and become the pupil of a new system. As Mr. Taylor rightly says:

"If Schmidt had been allowed to attack the pile of 47 tons of pig iron without the guidance or direction of a man who understood the art, or science, of handling pig iron, in his desire to earn his high wages he would probably have tired himself out by 11 or 12 o'clock in the day. He would have kept so steadily at work that his muscles would not have had the proper periods of rest absolutely needed for recuperation, and he would have been completely exhausted early in the day. By having a man, however, who understood this law, stand over him and direct his work, day after day, until he acquired the habit of resting at proper intervals, he was able to work at an even gait all day long, without unduly tiring himself."*

Here we have the system of scientific management at its best. It justifies the seemingly extraordinary claim that "the whole realm of science is brought to the aid of the humblest workman."

Schmidt was the gainer in wages, the company and the community in the amount of work done. With workers of finer intelligence and reactions, the self-respect and exhilaration which spring from achievement are as great as the increased wage. In this instance the prodigious increase in working capacity was in direct proportion to the physiological potentialities of the workman. Any one can see the difference between the ordinary methods of "speeding up" and this speed achieved by the efficiency engineer. He also sets up speed as one of his ends. He aims for speed not only to increase quantity of work, as with the pig-iron handlers, but regards it also as a function of quality.†

Now just in proportion as this function of speed is developed, *subject to the capacities of the human agent,* instead

* Taylor, op. cit., p. 59.

† "In the last process of stamping tickets and ticketing (in a cloth finishing establishment) the girls work without one superfluous motion, with a deftness very attractive to see; and both here and at book folding justified the claim made by Scientific Management that speed is a function of quality." Clark and Wyatt, op. cit., p. 244.

of as a *driver* of those capacities, it counts as a gain. Just so soon as the function of speed is disassociated from its effects on the worker, we revert to the old system of pace-making and speeding.

Such a reversion was seen in the case of the Bethlehem Steel Works. When the ownership of the works passed into the hands of Charles M. Schwab in 1901, the efficiency engineers were dismissed. But the machinery of their system was kept. Bonuses, premiums, and other inducements for great exertions on the part of the workers were continued, but without the spirit which had previously made these contrivances parts of a larger system, as in the case of Schmidt, the pig-iron man. The result was a return to the system of "drive," such as the world has seldom seen excelled.*

This, indeed, is one of the dangers of scientific management. Unscrupulous men can easily pervert it to their own uses. Its mechanical features, such as timing operations by a stop-watch, and the like, are easily copied, and unless they are correctly applied the workers can thereby be exploited more relentlessly than ever before.

But such perversions cannot fairly be charged against the system itself. They emphasize the dangers of this new instrument of efficiency; it may be used as a club as well as a crutch. But many invaluable stimuli are dangerous in the wrong hands. If the unscrupulous use of scientific management were all that could be charged against it, the system could defend itself easily enough. That more has been charged against it, it would be idle to deny.

More serious is the contention that the efficiency engineers themselves have failed to gauge fairly the tax of increased productivity upon the workers, and into the justice of this charge it behooves us to inquire.

* Gantt, H. G.: Work, Wages and Profits, p. 107. Published by *The Engineering Magazine*, New York, 1910.

2. BENEFITS OF THE NEW SYSTEM

We have seen that in the case of Schmidt, the pig-iron man, increased efficiency was attributed to the balance of exertion by enforced rests. In machine work, obviously, many more complicated factors intervene. Here scientific management obtains its marvelous results not only by teaching the worker the best possible way of accomplishing his task with the least time and effort, but also by removing all possible external obstacles. The management has, in advance, perfected his equipment and sees that it is always in perfect order and that the worker is regularly supplied with material in perfect order and condition.

In reorganizing the weaving room of a cotton mill, for instance,* the efficiency engineer spent a month in studying and timing the looms and the most expert weavers. He learned exactly how much time it was necessary for the loom to be stopped each day to remove and replace the bobbins, etc., and what proportion of time it should actually be weaving, when all unnecessary delays and obstacles were removed. After starting the first workers on their predetermined tasks, he found himself still dissatisfied with the condition of the looms and the way in which the warps and filling were supplied. The new system was again delayed eleven days until all external delays and obstacles, which might interfere with the accomplishment of the specified number of picks to be thrown by the loom, were removed. The first workers were then taught their trade anew by the most expert weaver, chosen as teacher, with the efficiency engineer to superintend and teach the teacher.

Another striking example of regularizing work under scientific management and saving the workers from avoidable delay was shown in the recent reorganization of the general machine shops of the government arsenal at Watertown, Massachusetts.† The most important manufactures in the

* Gantt, op. cit., pp. 143 ff.

† Statement of Secretary of War Stimson in regard to War Department's Experiments with Scientific Management, 1911.

arsenal are seacoast gun carriages—large structures with hundreds of parts, requiring many months for their completion. Shop methods at the different arsenals were believed to be fully abreast of the best general work in private industries of the same nature. Yet it was concluded that the general machine shop might be materially improved under scientific management. One of the chief aims has been precisely to regulate "the flow of work so that it shall be even and continuous."

"An expert in shop management was employed, and under his guidance the . . . orders for manufacture now go from the office to the shops with a much more complete arrangement and supply than formerly of drawings, specifications, lists of parts, list of material, and orders regulating the particular parts of the structure to be produced . . .

"There has been installed a planning room, equipped with personnel and appliances for the regular production of what might be called the time tables of the thousands of pieces which must travel through the various shops on their way from the stage of raw material to that of finished product, without collisions or unnecessary delays.

"The work of planning the course of component parts of the structures to be manufactured through the shops of the arsenal has been systematized, so that this course shall be regular and orderly, and the work shall at no time be held through the lack of some component which is not at hand when needed; and that no wasteful effect shall arise through congestion of work at particular machines, or the idleness of other machines or workmen, while waiting for the assignment of operations which should have been planned for them in advance."

Compared with such a régime, the crudity and chaos of ordinary systems stand out in glaring contrast. A revolution has been effected; a terrible waste has been checked, of that capital which alone is common and equal for all mortal beings: of *time*, "the daily miracle . . . the inexplicable raw material of everything." Hitherto hours, days, and weeks of employment have been habitually lost to the workers through no fault of their own, but through the sheer

incompetence of the management in performing its obligations and supplying materials and equipment fairly. No page in industry's history is more dreary and disheartening than the "time lost" by competent and willing workers, waiting, unpaid, for employment which might be fairly regularized. Indeed, the daily delays and irregularities of work involve more than the direct loss of wage and earning capacity. They are more subtly interfused into the day's work; and the psychological gain which springs from the elimination of such daily annoyance and friction is undoubtedly an important factor in heightening working capacity under scientific management.

The new organization of work has brought also a new emphasis upon the workers' physical surroundings. All those physical inconveniences which waste human strength and comfort and which are common rather than uncommon characteristics of our workshops,—such as bad air, bad light, overcrowding, dirt, and unsanitary conditions,—are all marks of inefficiency in the management. They are intolerable to the system which is based essentially on the observation and study of cause and effect. Where the ordinary management sees in the crudest so-called "welfare work" (better light, air, sanitation, and comfort) merely concessions to the labor force, the engineer sees them as indispensable parts of the equipment. They are the mere commonplaces of efficiency, without which the accomplishment of predetermined tasks cannot be expected.

Under such a system, as we have seen, the increase in production has been stupendous. Yet the picture has its reverse, which may not be ignored. The multiplied task has within it real elements of danger, and unless they are seen and neutralized at the outset, the new management may undo its benefits.

3. DANGERS OF THE NEW SYSTEM

It is clear that unless the working hours are proportionately shortened, or eased by rests, the physical or nervous

hardship inherent in any process is bound to be multiplied when the task is multiplied. This was true in the case of the weavers under scientific management, and is almost inevitable in all machine processes. Take, for another example, the case of girls who wind the bobbins for filling, in a cotton mill. They watch the thread from 18 bobbins, stopping and replacing the bobbins by throwing their weight upon foot pedals. The girls' work was concentrated by providing doffers to place the bobbins on the warp, formerly done by the girls themselves. A time study was made and the task so increased that the girls earned from $8.00 to $10.50 a week, in place of their previous salary of $7.00 to $7.50. The hours of labor were not changed. It is easy to see that the increased stamping of the pedals, necessitated by the larger task, was bound to be more exhausting than before.*

So, too, with the girl spool tenders. "In replacing the bobbins and fastening the broken threads with a tier knot the girls have to stoop down almost to the floor." Naturally, then, the increased task requires proportionally more continuous stooping.

Moreover, as we saw in discussing the strain of industry, the increased concentration of attention upon more limited and intensive tasks makes for monotony and increases effort. This, it is true, is counteracted under scientific management by the worker's new interest in earning a larger wage, conditional upon the quality as well as the quantity of a given task. Where the payment of a bonus, over and above the regular day- or piece-rate, does not lead to an undue strain of effort, it undoubtedly acts as a new and important psychological motive in arousing interest in work. And this interest, in the intricacy of our psychological powers, itself develops capacity and reduces effort.

The new order of production is thus infinitely complex in its effects upon working capacity. No offhand or general statement can gauge its true results. When, therefore, the efficiency engineer presents to us as complete answer the fact

* Clark and Wyatt, op. cit., pp. 256–257.

that the predetermined task has been accomplished and that bonuses have been earned by foreman and workers, he does not answer our demand to learn the effect upon the workers.

Mr. Gantt, for instance, in his interesting book, shows by graphic charts how the working capacity of men and girls in a variety of establishments was remarkably increased. He insists upon the benefit accruing to the workers under scientific management, not only in efficiency and wages, but in habits of industry, in self-respect and improved personal appearance. He states in general, that this improvement is more marked in girls than in men, and that under the new system the "girls invariably acquire better color and improve in health."

But with a system whose possibilities for harm as well as for good are so striking as the new efficiency, we are justified in asking for more specific data. The burden of proof is upon the new system to show that its marvelous results have been attained by legitimate means, as in the case of the carefully observed pig-iron handlers, without extra strain upon the vitality of the workers.

As applied to women, scientific management is so recent and has, as yet, affected such a comparatively small number, that it is perhaps unreasonable to expect much accumulated evidence. An open-minded and painstaking investigation into the effects of scientific management upon working women was recently made by Miss Edith Wyatt, and yielded results more or less inconclusive as to the effect on health. In three large establishments studied, the new management seems to have "resulted fortunately for the health of the workingwomen in some instances and unfortunately in others." To this impartial observer "the best omen for the conservation of the health of the women workers under Scientific Management in the cotton mill was the entire equity and candor shown by the management in facing situations unfavorable for the women workers' health, and their sincere intention of the best practicable readjustments."*

* Clark and Wyatt, op. cit., pp. 260 and 266.

What we need as regards both men and women (and the only answer which will allay the suspicions aroused by scientific management) is more knowledge as to the ultimate physical adjustment of the workers to the heightened intensity of their tasks.

This was a subject which preoccupied the attention of the man who was in some sort a forerunner of the efficiency engineer—Ernst Abbé. He, too, was a student of working capacity. He, too, sought the *optimum* in which men accomplished most in the shortest space of time. But he was concerned with the effects of heightened intensity upon the development of his workers not only as economic vessels and units of production, but as men and citizens.

Now, it is clearly self-evident that the efficiency engineer desires the permanent welfare of his employes. Permanency of the labor force is a part of efficiency, since the training of employes represents a concrete investment of money, time, and effort. Scientific management would brand as essentially inefficient such management as that in many department stores, where the army of employes shifts almost like an army of tramps. In one large and well known department store in Boston, for instance, during a single year, from among less than 1,000 regular employes, 708 left after employment averaging fourteen weeks.* Only 279 worked an entire year. Such a record, resulting largely from underpay, is a fair gauge of inefficiency. The "system of drive" also, which merely keeps replacing its workers as they are used up or worn out by overwork and unrelieved intensity of effort, is condemned by the engineers as essentially inefficient. They aim to set tasks which the workers may accomplish and "thrive under." In comparison with this, the difference in Abbé's attitude towards his workers was only a matter of emphasis. Yet, as we all know, nothing is in the end more potent or revolutionary than the intangible spirit which animates a new system and sets its tone, and of this emphasis upon the work-

* This did not include the temporary employes engaged for the Christmas season.

ers as independent social units, scientific management has still much to learn.

The practical difficulties of gauging the individual adjustments to work are undoubtedly huge. But it is the business of scientific management to approach such problems of employment in the same spirit which has solved the vexed problems of equipment.

What observation of the workers is comparable to the genius for both details and underlying principles shown in the maintenance of belting, in a railroad shop described by Mr. Harrington Emerson? The care of belting at one of the main shops had cost about $12,000 a year, or $1,000 each month.

"It was so poorly installed and supervised that there was an average of twelve breakdowns each working day, each involving more or less disorganization of the plant in its parts or as a whole. . . ."

Scientific management then entered:

"The worker in actual charge of belts, a promoted day laborer, was given standards, and took his directions from a special staff foreman, only one of whose duties was knowledge as to belts. The foreman had received his knowledge and ideals from the general chief of staff, who had made belts a special study, and this general chief of staff had been inspired and directed by a man who had made a nine years' special study of belts and who was the greatest authority in the world on the subject. The belt foreman had as much of this knowledge at his call as he could absorb, but he in turn was in immediate contact with each individual belt, with the machine it was on and with the worker using the machine. The chief of staff learned as much from the belt foreman as the belt foreman learned from the chief of staff. The belt foreman learned as much from the machinists as they learned from him. The cost of maintaining belts fell from $1,000 a month to $300 a month; the number of breakdowns declined from twelve each working day to an average of two a day, not one of them serious."*

* Emerson, Harrington: Efficiency as a Basis for Operation and Wages, p. 61. Published by *The Engineering Magazine*, New York, 1909.

Here we have the greatest authority in the world sought as consultant for the life of belting. What first class authority, nay, what specialist at all, is called in as consultant for the lives of mortal men and women singularly responsive and singularly influenced by the new and unstudied forces released by the new system of production?

4. SCIENTIFIC MANAGEMENT AND COLLECTIVE BARGAINING

The solution of these problems, connected with the determination of strains upon the workers, will probably be contingent upon the solution of another, which it is the reproach of scientific management to have left so far unsolved. This is its relation to labor organization; its failure to enlist the forces of a devotion as passionate as the instinct for self-preservation itself.

In a recent valuable paper on "Organized Labor's Attitude Toward Industrial Efficiency,"* John R. Commons observes that the conflict between unionism and scientific management is found at the point where management weakens the solidarity of the labor unions. Where, for instance, the principle of individual bargaining replaces collective bargaining, the instinctive and reasonable hostility of labor arises. It is true, as evidence showed before the Interstate Commerce Commission, that in a number of important establishments, union and non-union men have worked peaceably under the new management.† Nor is there any reason why they should not do so. The hostility of labor which resents the stop-watch of the engineer, his impersonal and unfeeling measurement of human powers in mechanical and psychological terms, is bound to yield to tact and persuasion. This is a hostility bred of sentiment, which

* *The American Economic Review*, Vol. I, No. 3. September, 1911.

† Tabor Manufacturing Company of Philadelphia; Canadian Pacific Shops at Angus, Montreal; Manhattan Press of New York; Plimpton Press of Norwood, Massachusetts, and contract work under Frank Gilbreth and others.

it is reasonable to suppose that time and education may gradually dissipate. But the unionist's desperate dread of losing his hard-won collective bargaining power (the essential basis of his solidarity) can be met only by "converting this craving for harmony and mutual support, as well as the impulse of individual ambition, into a productive asset."*

The material results of industrial efficiency are such that the new system is inevitably bound to spread and affect the fortunes of a constantly growing number of wage-earners, men and women. This is the reason why its attitude towards collective bargaining is of such vast consequence now, while the relations between the engineers and the unions are still uncrystallized and in process of formation.

The unions themselves have, on the whole, failed as yet to grasp the significance and inevitableness of the new order of production. They have confused its outward forms and economies, such as the bonuses, with the old system of "drive." They often resent, as indeed it is only human at first to resent, the enforced substitution, however desirable, of new habits for old. They have belied the system and wilfully closed their eyes to its marvelous possibilities; but in such opposition the forces of unionism are beating against a dead wall. Scientific management is bound to triumph with them or despite them. Labor has thus before it a unique opportunity, still largely unrecognized, to strengthen its cause and to gain for itself a fair share in the new benefits of science. Its bitter experience in the past, especially in relation to new inventions such as the introduction of machinery, whose benefits capital and not labor has so largely absorbed, explains in part the opposition of labor to scientific management.

The forces of repression so threaten unionism on all sides, perverting even industrial efficiency itself to their malign uses, that the leaders of the new order, free to realize its wider implications and benefits to laborer as well as to employer, are under special obligations to spend their best ef-

* Commons, op. cit., p. 472.

fort upon this, doubtless their most difficult problem. "Liberty," said a true lover of his race, "does not fail those who are determined to have it":* and the same is true of *justice.*

"The fundamental defect," as Professor Commons puts it, "is the failure to investigate first the bargaining relations and then to organize those relations in such a way that conflicts of opinion and interest will be furnished a channel for expression and compromise; and then, last of all, to work out the standards and records under the direction of and subordinate to this organization of the bargaining relations. I do not pretend to say how this shall be done. It also is a matter for investigation in each case. I only contend that the individual bargain should be eliminated as far as possible and the collective bargain substituted."†

So far as concerns the legislative restriction of working hours which our study has led us to advocate, the new efficiency is no obstacle or check, but rather an incentive.

It represents the progressive employers whom the state benefits together with their employes, in checking the less efficient and unscrupulous competitors. Excessive hours, like overtime and under pay, are marks, often unrecognized, of inefficiency. That scientific management itself has shortened the workday in fair proportion to the increased productivity of its workers, no one can justly maintain. In regard to both hours and conditions the new system has still to share its marvelous gains more equitably with labor. In the present status of our industries, therefore, where the true efficiency is still exceptional, legislation to restrict the working day is still a cardinal need.

* "Libertà non tradisce i volenti."—Garibaldi.

† Commons, op. cit., p. 471.

VIII

THE ENFORCEMENT OF LABOR LAWS

WE have now reached a more technical aspect of our subject which needs close consideration—the administration of our labor laws. For in the end the whole test and crux of labor legislation—indeed its whole excuse for being—is precisely its enforceability and enforcement. We do not seek laws limiting the hours of labor for the sake of having them on the statute books, nor for any academic purposes whatever. We seek them purely for the sake of securing adequate control of the length of the workday. What then are the essential desiderata for enforcement? What assists and what hinders the factory inspectors in their difficult office of administering these statutes, particularly that statute which combats industrial fatigue by limiting the hours of labor? Our inquiry narrows itself down to this specific question. We must consider what kind of laws tend, on the whole, to get themselves best enforced.

It is in this connection that the employment of women at night and in the evening after the day's work plays so important a rôle. Overtime work may, in fact, be called the key to the whole matter of regulating the hours of labor. More than 30 American states have enacted laws prohibiting, in various degrees, the employment of women more than a specified number of hours. But only three states—Massachusetts, Indiana, and Nebraska—have set a legal closing hour after which employment is illegal. Moreover, many states, as we shall see, allow various exceptions for overtime which interfere gravely with the enforceability of their laws. The difficulties of inspection become almost insuperable.

Let us first make clear the distinction between the rigid law which prohibits overtime and night work, and the elastic law which does not.

1. THE RIGID LAW: HISTORICAL DEVELOPMENT IN MASSACHUSETTS

The rigid or non-elastic law is one which provides fixed boundaries for working hours. It protects women from working after a specified hour at night, and more than a given number of hours by the day or week. The best exemplar of this kind of law in the United States is the Massachusetts statute which prohibits the employment of women in textile mills more than ten hours in one day, or more than fifty-four hours in one week, or before six o'clock in the morning or after six o'clock in the evening.

A moment's thought will show the advantages for enforcement of laws thus rigidly framed. The law is final. Its provisions are clear cut. Employers, employes, and inspectors know without disagreement or argument what constitutes a violation. Work continued after the specified closing hour is conclusive evidence of violation. The factory inspector can see at a glance, without further machinery, whether or not employes are being illegally kept at work.

The Massachusetts textile law has not been hastily enacted. It is the fruit of almost forty years of experience. After two commissions of investigation in 1866 and 1867, the first Massachusetts law for adult women was enacted in 1874. From that date to the present day there has been slow but steady progress making the law more and more rigid and definite in its requirements, as experience proved how enforcement was hindered by the laxness of the earlier statutes. It is worth while to trace this course of legislation in Massachusetts, since the whole case for an exact and rigid law with fixed legal opening and closing hours, rests not on any theory but on the direct evidence of experience. No arguments could be more telling than the fact that our oldest industrial

state, like England before it, has had to amend its laws dealing with the hours of labor steadily in the direction of greater rigidity and exactness.

The first statute for adult women enacted in Massachusetts prohibited their employment in manufacture more than ten hours in one day and sixty hours in one week. But this law was inoperative for some years because a fine was prescribed only for its "wilful" violation—a loophole through which obviously any offender could easily escape. The law of 1874 was "practically not in operation until in 1879 when the word 'wilfully' was stricken out by chapter 207 of that year."*

The law of 1874 had also allowed two other exemptions which added greatly to the difficulties of enforcement. This was in permitting overtime after the ten-hour day, in order to make good any time lost for repairs within the same week, or in order to make one day in the week shorter.

"The time devoted to starting and stopping machinery was absurdly prolonged. Again, where a factory ran an eleven-hour day, each woman and child was required to leave for half an hour in each half day, but her neighbor tended two sets of machinery during her absence—'doubling up' this was technically called."†

In order to meet these evident defects in the operation of the law, various amendments were accordingly passed. In 1880‡ the posting of a notice was required, stating the daily hours of work; in 1886§ it was required that the notices should contain an additional statement of time allowed to stop and start machinery, and the time given for meals. Even this amendment proved too lax. In the very next year, 1887, the law was again amended|| to require the post-

* Report of the Convention of the International Association of Factory Inspectors, 1894, p. 65.

† Massachusetts Labor Legislation. S. S. Whittlesey. Supplement to the *Annals of the American Academy of Political and Social Science.* January, 1901, p. 13.

‡ Laws of 1880, chap. 194.

§ Laws of 1886, chap. 90.

|| Laws of 1887, chap. 280.

ing of the exact hours when work began and stopped and also hours when meal-time began and ended.

The practice of lengthening the day's work by "doubling up" was also attacked in 1887.* In factories where five or more women began work at the same time, it was required that meal-time should be given them at the same hours, without imposing additional work upon women who began work and had their meals later.

Another important amendment enacted in 1887 aimed to correct another evasion of the law which the inspectors had found very general.

> "The most trivial accident to the machinery which, in itself, might not have entailed an appreciable loss of time, had again and again been made the pretext for much lengthened overtime employment."†

This abuse was attacked by allowing overtime for repairs only when stoppage lasted over thirty minutes, and after a full written report had been sent to the chief inspecting official. A special fine was prescribed for false reporting.

Such were some of the successive amendments enacted to assist the enforcement of the law by making its technical requirements more rigid. More important still were successive enactments cutting down the period of hours within which the legal workday was allowed to fall.

In 1890‡ for the first time legal opening and closing hours were set for the day's work. This was a step of far-reaching importance. The absence of a fixed closing hour had previously been the most serious obstacle to the enforcement of the law. It allowed women to be employed by night as well as by day. Moreover, it made almost unenforceable the ten hours' limitation of work. So long as women might be employed until any hour of the night at will, it was practically impossible for the inspectors to detect violations. Unless they remained actually on the premises they could not

* Laws of 1887, chap. 215.
† Whittlesey, op. cit., p. 14.
‡ Laws of 1890, chap. 183.

know when work stopped. The law of 1890, therefore, provided that the ten-hour workday must fall between 6 a. m. and 10 p. m. The employment of women in manufacture was prohibited before and after those hours.

Even this limit of hours, however, proved inadequate for enforcement. So long as it was permissible to employ women ten hours at any time between six o'clock in the morning and ten o'clock at night (a period of sixteen hours), it was still exceedingly difficult to enforce the law effectually.

Moreover, a practice grew up known as "swapping." One manufacturer would employ women ten hours between six o'clock in the morning and six o'clock in the evening, and another manufacturer would employ them additional hours up to ten o'clock at night. This, of course, entirely destroyed the effect of the law. Hence, after many defeats and more than a dozen years' agitation by the trade unions and other interested persons, the so-called "overtime bill" was passed in 1907.* This provides that in Massachusetts' greatest manufacture, the textile industry, women may not be employed before six o'clock in the morning nor after six o'clock —instead of after ten o'clock—in the evening. This rigid provision, which copies the still more definite British textile act, has finally been successfully enforced.

Accompanying these successive efforts to cut down the period within which the legal workday must fall, there have been successive reductions of the legal day's and week's work. In 1883† the ten-hour day was extended to women employed in mechanical and mercantile establishments. In 1892‡ women's hours of labor in manufacturing and mechanical establishments were reduced to fifty-eight in one week. Eight years later, in 1900,§ the same reduction was made for women in mercantile establishments, excepting that retail stores were exempted from this provision during December. In 1904 the exemption was repealed|| and work was limited to

* Laws of 1907, chap. 267.
† Laws of 1883, chap. 157.
‡ Laws of 1892, chap. 357.
§ Laws of 1900, chap. 378.
|| Laws of 1904, chap. 397.

fifty-eight hours a week during the whole year. In 1908* the week's work in manufacturing and mechanical establishments was reduced to fifty-six hours.† Finally, in 1911, the weekly allowance of hours was reduced to fifty-four.‡

2. THE RIGID LAW: HISTORICAL DEVELOPMENT IN GREAT BRITAIN

In this consistent sequence, extending through a long series of years, Massachusetts has followed the earlier experience of England. We find there, extending over an even longer period, a similar movement towards shorter and more rigidly defined hours, in the interest of enforcement.

In England the necessity of having fixed opening and closing hours was recognized in the very first effective statute limiting hours of labor. This was the British act of 1833 which forbade the employment of young persons under eighteen years in textile mills between 8.30 p. m. and 5.30 a. m., or more than twelve hours in any one day. There were other regulations for young children which need not be considered here.

The British law of 1844 was the first statute in any country to limit the working hours of adult women. It extended to them the provisions of the act of 1833, thus providing for all women employed in textile mills a maximum number of working hours and a period of rest at night between specified hours. From the beginnings of legislation it was realized that the effective enforcement of any limitation of hours by day was dependent upon the establishment of a fixed closing time at night.

The act of 1847 reduced women's hours of labor in textile mills to ten hours in one day. But the advocates of restriction, led by Lord Shaftesbury, were defeated in their

* Laws of 1908, chap. 645.

† Except that in any establishment "where the employment is by seasons," the week's work may be fifty-eight hours, if the total number of hours in the year does not exceed an average of fifty-six hours a week.

‡ Laws of 1911, chap. 484.

attempt to have work at night prohibited between 6 p. m. and 6 a. m. instead of the original terminal hours. The experience of the factory inspectors showed very early, what was shown later in Massachusetts, that it was almost impossible to enforce the law effectively, so long as it was permissible to employ women at any time within a period of fifteen hours, that is, between 5.30 a. m. and 8 p. m.* It was realized that the textile law would be practically non-enforceable until a so-called "normal day" should be established. This meant that the legal workday should be required to fall between specified hours and within a fixed period of time, just equal in duration to the legal workday *plus* meal times.

Accordingly, in 1850, further legislation remedied this defect in the textile law. It provided that women might be employed ten and one-half hours in the day, and it provided also that the workday must fall in the twelve-hour periods between 6 a. m. and 6 p. m. or 7 a. m. and 7 p. m., with one and one-half hours off for meals. Under this arrangement the "normal day" between the fixed opening and closing hours exactly coincided with the ten and one-half hours of labor allowed, plus meal hours. It also made possible a twelve-hour period of rest at night.

Subsequent acts have still further reduced the length of the workday and have made the British textile law as nearly definite and exact as is humanly possible. Work must fall between 6 a. m. and 6 p. m. or 7 a. m. and 7 p. m., with two hours off for meals on week days; and on Saturdays it must fall between six o'clock in the morning and twelve o'clock at noon, or seven o'clock in the morning and one o'clock in the afternoon, with one half hour off for meals. It may not begin or end on the half hour.

* See a similar complaint by the New York Mercantile Inspector in the year 1910. "The part of Section 161 relative to the hours of labor of females from sixteen to twenty-one years of age, is one of the most difficult provisions of the law to enforce. . . . The provision calling for ten hours' work between the hours of 7 a. m. and 10 p. m., allows a period of fifteen hours per day in which to perform ten hours' work." Report of the New York State Department of Labor, 1910, p. 132.

Of the effects of these rigid provisions on both industry and labor, one of the foremost English economists writes with enthusiasm.

"How potently," says Mr. Sidney Webb, "the additional freedom which the law thus secures, to master as well as to man, has reacted on the efficiency of the industry is, at the opening of the twentieth century, one of our proudest boasts. In spite of the keenest foreign competition, the Lancashire cotton mill, in point of technical efficiency, still leads the world, and the Lancashire cotton spinner, once in the lowest depths of social degradation, now occupies, as regards the general standard of life of a whole trade, perhaps the foremost position among English wage-earners."*

Following the first textile legislation, the acts were slowly extended to take in other industries, such as print works (1845); bleaching and dyeing (1860); lace works (1861); bake houses (1863); earthen ware, lucifer matches, percussion caps and cartridge packing, paper-staining and fustian cutting (1864). Between 1867 and 1907 the acts were still further extended by taking in many other subsidiary branches of industry and the so-called "workshops," where work is done by hand.

3. THE ELASTIC LAW: HISTORICAL DEVELOPMENT IN GREAT BRITAIN

In all the various so-called "non-textile" acts which followed the original textile legislation, the same general principle was followed, providing for a maximum number of working hours by day, between fixed hours before and after which it was illegal to employ any women, and a period of rest at night. But the general laxness of the non-textile acts and the many exceptions allowed have proved as damaging to enforcement as the rigidity of the textile acts proved helpful.

The non-textile acts have nominally prohibited night-

* Hutchins, B. L., and Harrison, A.: A History of Factory Legislation. Preface by Sidney Webb, p. x. 2nd Edition revised. London, King, 1911.

work and have provided for a fixed workday; but in a large number of trades these restrictions have been deliberately brought to naught by allowing special exceptions up to a late hour of the evening.

Thus, for instance, the general act for non-textile factories provides that women may not be employed therein more than ten and one-half hours in one day, and that employment must fall in the twelve-hour periods between 6, 7, or 8 a. m. and 6, 7, or 8 p. m., with one and one-half hours allowed off for meals. But in certain trades overtime is allowed for a variety of reasons, such as press of work at certain seasons, or when the material to be manufactured may be spoiled by weather. In such trades women may be employed twelve hours in one day and as late as 10 p. m.; that is, employment is supposed to fall within the fourteen-hour periods between 6, 7, or 8 a. m. and 8, 9, or 10 p. m., with two hours allowed off for meals.

The experience gained in the enforcement of the textile law was ignored. The laxness, or margin of supplementary hours allowed for evening overtime in the non-textile laws, has long been not only a hardship to the workers but a constant obstacle to the enforcement of these more lax statutes. The legal permission to employ women until ten o'clock in the evening has led to uncontrollable illegal employment after that hour. The difficulties of enforcement have been practically insuperable. In this, inspectors and all fair-minded observers agree.*

Gradually, however, this state of affairs has been found intolerable. It has been realized that evening overtime must be curtailed and the closing hour must be set earlier, if the non-textile acts are to be made of practical benefit. Beginning with the Consolidating Act of 1878, therefore, we find the beginnings of a change in this direction. From among many, we may cite a few examples of the gradual stiffening of the non-textile acts and the restriction of overtime work.

* See Part II of this volume, pp. 464–472.

The act of 1878 allowed women to be employed overtime in non-textile factories, as described above, 48 days during the year and on five days in any week. In the act of 1895 such overtime work was reduced to 30 times during the year and permitted on only three days of the week.

Similar overtime employment has been allowed also for articles of "perishable nature." This exception includes such places of employment as fruit-preserving establishments. In the act of 1878 such employment was allowed therein 96 times during the year and on five days in the week. In 1895 such overtime was cut down to 60 times during the year, and in 1901 it was further reduced, being allowed only 50 times during the year, and on not more than three days of the week.

By a retrograde movement a special amendment had been inserted into the act of 1891, exempting from all operation of the acts, "the process of cleaning and preparing fruit so far as necessary to prevent the spoiling of the fruit on its arrival at a factory or workshop, during the months of June, July, August, and September." This wholesale exemption allowed women to be employed unlimited hours, by day or night, on certain processes in the fruit preserving establishments. Though the exemption was meant to apply only to "cleaning and preparing fruit on arrival," its effect was to nullify totally the laws governing hours of labor in those establishments. The legal permission to work unlimited hours on certain processes led inevitably to the illegal employment of women in all processes.

Of a similar consequence from the exemptions granted to the fish-curing trade, the British Chief Inspector of Factories wrote in discouragement in 1901:*

"Starting with an exemption for one process, that of 'gutting, salting, and packing,' the industry would seem to have shaken itself gradually free from control, until now we find fish that have been in salt for several weeks dealt with as

* British Sessional Papers. Vol. X, 1901. Report of the Chief Inspector of Factories and Workshops, pp. 338–339.

perishable articles. Given plenty of time and unsuitable surroundings, every article of food is to some extent perishable, and when a herring has been kept in salt for some weeks there is no reason for working on it at night except the reason that the day will bring other work, and in this seems to lie the cause of much of the late and irregular hours of the fish-curing trade. . . ."

Under the British law, however, the Home Secretary is empowered to issue "special orders," extending or restricting the overtime exemptions. After twelve years of agitation by the factory inspectors and others against the abuses of overtime work and the impossibility of enforcing these useless statutes in fruit-preserving establishments, a special order was issued by the Home Secretary in 1907. This was in line with all previous experience, which had proved that laws governing the hours of labor cannot be enforced without a fixed opening and closing hour. The order prohibited employment of women in fruit-preserving establishments between 10 p. m. and 6 a. m. This still leaves a very long workday in these establishments, but an effective step has been taken toward ultimate protection of the workers by the prohibition of night work.

Another interesting example of the gradual tendency to restrict evening overtime work and limit the workday more strictly by an early closing hour is shown in the history of British legislation regarding the laundries. Before 1895 the laundries had not been subject to the Factory Acts. In the act of that year they were included for the first time, but instead of being governed by the same hours of labor as other establishments, a different and unenforceable set of hours was prescribed for the laundries. No closing hour was set, so that the fourteen-hour workday permissible under the law might be and was worked either by day or by night. It was not until a special act was passed in 1907 that women employed in laundries obtained protection at all comparable to that of women in other occupations.

This law still permits a very long working day and work-

ing week (sixty-eight hours), and exemptions of many kinds still defeat its effective enforcement. But a beginning has been made by providing that the workday must end at 9 p. m.

In their report for 1909, the women factory inspectors noted that the number of complaints of excessive hours in laundries was steadily declining, showing how the fixed and earlier closing hour was facilitating the enforcement of the law. "It may be hoped," says the latest edition of the standard history of British factory legislation, "that the act of 1907 will be a step towards the normal day which the experience of generations in regard to other industries has shown to be in the best interests, not only of the workers, but of the trades concerned."*

A fourth employment (besides non-textile factories, fruit-preserving establishments, and laundries) in which a special laxity of hours has been legal until recently, are the flax scutch mills. In the Consolidating Factory Act of 1878 and earlier, these mills were totally exempted from all restrictions of hours by night as well as by day, provided that no children or young persons were employed therein, and provided that employment did not continue longer than six months in the year. In 1907 this special exemption was repealed and the flax scutch mills included in the scope of the textile acts, in order to bring the British laws into conformity with the terms of the Berne Convention of 1906 on night work, to which Great Britain had been a party.†

Thus the history of the factory acts in Great Britain shows as conclusively as in Massachusetts, how the laws limiting the workday have had to be consistently made more exact and more rigid, in the interest of enforcement. The process is still far from complete. Twenty years ago, Mr. Sidney Webb pointed out the anomaly in differentiating textile from non-textile laws. When the textile factories were first singled out for regulation, the cotton trade was

* Hutchins and Harrison, op. cit., p. 256.

† Bulletin of the International Labour Office. English Edition. Vol. I, No. 1, 1907. Page 38.

practically the only great industry employing women and children, and work therein was far more exacting than in any other industrial employment. But with the increase in the number of workers and intensity of work in non-textile employments, the distinction has become purely arbitrary. Its abandonment and the inclusion of non-textile occupations in the stricter statutes are only matters of time. Overtime employment of all young persons under eighteen years has been prohibited since 1895. British legislation moves "slow, how slowly," but the best opinion in England holds that "the overtime exception is doomed."

4. ELASTIC LAWS IN THE UNITED STATES

England is thus slowly emerging from a past phase of industrial experience and legislation. Overtime favors to special interests are going out. But meanwhile, in the United States they are, to some extent, coming in.

This refers particularly to one industry whose quite unrecognized physical hardships have been dwelt upon in a previous chapter. Six states (four of them within the year 1911) have enacted laws which limit women's hours of labor, but in which the canneries are totally exempted. These states are California, Maine, Michigan, Ohio, Utah, and Washington.* Unlike the British and Continental legislation, which at least attempts to fix the amount and extent of overtime allowed for perishable articles, the American laws exempt the trade *entirely* from any restriction of hours.

So, too, in Connecticut, Louisiana, and New York, mercantile establishments are by statute exempted from all restrictions upon the working hours of women during the Christmas "rush."† In these cases, women are totally de-

* Similar action has been taken in 1912 by Maryland, New Jersey, and New York.

† In Connecticut between December 17th and 25th (provided employer gives seven holidays with pay); in Louisiana during twenty days before Christmas; in New York between December 18th and 24th, applying to girls between sixteen and twenty-one years. Similar exceptions previously existing in Massachusetts and Oregon were repealed, respectively, in 1904 and 1909. A similar exemption was enacted in New Jersey in 1912.

prived of protection when it is most urgently needed. But we need not here dwell at length upon such total exemptions, since they do not affect the enforcement of laws, which we are now considering. In these cases there is no law; hence there can be no enforcement. But these exemptions are the more deplorable because they mark a departure from previous usage in America.

In the United States the slower and more cumbrous British method of legislating for one industry at a time has been replaced by a more reasonable and inclusive system. We have seen that Massachusetts requires an earlier closing hour in textile mills than in any other occupation; but in no case has an American law restricting women's hours of labor *been limited to any one special industry.* Laws governing the hours of labor in manufacture have included *all* manufacture. Broadly speaking, the American usage has been to include all industries in the laws. With the recent exception of canneries and Christmas trade, the injurious custom of granting overtime to special industries has not obtained.

But other exceptions and laxities in American laws have been as disastrous for enforcement as the overtime provisions for special trades abroad. The most flagrant of these is the almost universal absence of a fixed legal closing hour, to which we have previously referred.

It is a startling fact that only three American states (and only one of them a great manufacturing state) have prohibited women's employment at night—a form of work which, as we shall see in a subsequent chapter, all the civilized nations of Europe have striven to abolish by international treaty. Indeed, the laws of California, Illinois, Oregon, Washington, and Wisconsin specifically state that work may be so arranged as to permit the employment of women for eight or ten hours *at any time* during the day or night. Consequently, some years ago an enterprising mill owner in the state of Washington attempted to employ the same women almost twenty consecutive hours in a mill (from noon on one day to near noon on the next day, with an intermission at midnight). He

maintained that the two periods of ten hours were divided into two days' labor by the convenient line of midnight. Fortunately the commissioner of labor interpreted the law otherwise and put a stop to this particular form of exploitation.

But in all those states which limit women's employment without fixing a closing hour, night work is entirely legal and often customary. Moreover, the fixed closing hour has been found indispensable not only to check the employment of women at night, but to make possible the limitation of work by day. The two things are practically inseparable.* Hence all those states which fail to provide a legal closing hour must have maximum difficulties in enforcing their laws.

Besides the absence of a legal closing hour, other laxities in the American laws help to defeat their enforcement. Thus eight states† are satisfied to prohibit more than a fixed amount of work during the *week*, leaving the separate *days'* work on various pretexts wholly unrestricted. If work ends (or is supposed to end) early on Saturday or on any one day, the other days may be as long as the employer pleases, provided that the total week's work does not exceed the specified number of hours.

Such a statute is obviously intended to afford to working people a half holiday on some one day of the week and to compensate employers for such a half holiday by allowing employes to work longer on other days. But in practice the intent of the statute is easily evaded. In some New York mercantile establishments, for instance, the day's work is lengthened by overtime, and instead of giving a compensating half holiday the employer complies technically with

* Le Travail de Nuit des Femmes dans l'Industrie. Rapports sur son importance et sa réglementation légale. Préface par Prof. Étienne Bauer, p. viii. Jena, Fischer, 1903.

† Arizona (applying to laundries only), Connecticut, Georgia, Maine, Minnesota, New Hampshire, Rhode Island (all applying to manufacture); New York (applying to mercantile establishments for girls between sixteen and twenty-one years). In Louisiana and Pennsylvania the hours are unrestricted on Saturdays in mercantile establishments.

the statute by allowing employes to come to work a single hour later in the morning of one day!

Moreover, how enforce such a statute? Any one can see how disastrous for enforcement it must be. The particular value of the rigid textile laws of Massachusetts and England is that they are automatic and tend to be more or less self-enforcing. Precisely the opposite is true of the shifting schedule of hours. When an inspector finds women employed in the evening, he has no means of knowing whether the long day will be compensated by a shorter day later in the week, so that the total week's work may not exceed the number of hours allowed by law.

"The claim is always made," says the New York Mercantile Inspector, "when employes are found working over ten hours per day, that it is for the purpose of making a shorter day of some one day of the week. This compels the inspector to prove the total number of hours per week, and makes it much more difficult. . . . To prove the actual hours worked per day or week is almost impossible unless we secure the aid of the employe. The fear of losing their employment has deterred many employes from rendering assistance."*

It is out of the question for the inspector to return each day to see that a shorter compensating day is allowed. Without an army of inspectors and a degree of supervision such as exists nowhere in the world, it is impossible to enforce a law made up of exceptions.

This is the reason why such a statute as the New York factory law is so thoroughly unsatisfactory. This law was amended in 1907, so as to copy precisely the most lax and unworkable portions of the British non-textile factory acts. The New York factory law sets no closing hour for women.† Moreover, it allows overtime after the ten-hour day, but limits work to twelve hours. The law permits an employer to

* Report of the New York State Department of Labor, 1910, p. 132.

† The provision which prohibited employment of adult women in factories between 9 p. m. and 6 a. m. was held unconstitutional by the New York Court of Appeals in 1907. People v. Williams. 189 N. Y. 131.

work his women employes twelve hours a day on five days a week regularly during the whole year; it permits him to work them twelve hours a day on three days of the week if he does so "irregularly," that is, not as a regular rule.

Even further concessions to irregularity are made. When it is difficult to fix the weekly hours of labor in advance "owing to the nature of the work," the law permits employers to dispense with posting a printed schedule showing the required working hours for each day of the week. This posting is a mechanical device which, as we saw in discussing Massachusetts, has been found indispensable for enforcement, because the presence of persons on the premises at any other hour than those stated in the printed schedule is *prima facie* evidence of violation. Precisely when this provision is most necessary, when overtime is most sought and the difficulties of inspection are greatest, the New York law allows the posted schedule of the week's work to be omitted by permit of the commissioner of labor.

When we realize that the total number of factory inspectors in New York state is 80; that they are charged with the inspection of all the factories in the state (over 30,000 in 1910), all the stores, all the tenements licensed for home work or applying for license; that they must enforce the labor laws regarding the fencing of dangerous machinery, the ventilation and sanitary condition of workrooms, as well as those which provide for the inspection of tunnels, for the payment of wages, for the enforcement of the eight-hour law on public works, all the child labor laws, and others besides—it is apparent that a law to limit hours of labor, so full of exemptions, so little calculated to be *enforceable*, sets the inspectors a genuinely impossible task, and must remain, more or less, a dead letter.

It is true that in New York state the difficulties of administration are greater than in other states, on account of the larger field to be covered and the far greater number and variety of establishments and employes. But the conditions are not essentially different in other states.

5. TWO TESTS OF EFFICIENCY

What then is the general state of administration in the United States? Can we fix upon any general tests of efficiency? In so large and complex a field we are again forced to limit ourselves to a few definite points of discussion. From among many possible items we may choose two, as fairly good indices of intelligence and ability in administering the laws. The first of these is the character of the yearly printed report of the state labor bureau or department; the second, its means of gauging the effect of industrial occupations on the health of the workers.

(a) The Annual Report

To many persons our first item may not seem a fair test of efficiency. The yearly printed report seems a mere formality, a conventional requirement, which has resulted in libraries full of dead statistics and verbiage. But if the statistics are not dead nor the comments mere verbiage!

In Great Britain and other foreign countries the yearly report has been found an essential and effective, though indirect, aid to administration. In the first place, the report is a yearly public accounting, a yearly focus or review, which discloses the internal working of the inspection department. In a word: *it turns on the light.* It reveals the department's efficiency or inefficiency. It acts as a valuable check upon the field work, since it is based upon the inspector's daily activities. A good report presupposes and indeed necessitates an adequate system of supervision, daily reporting, and standardized record keeping by the field inspectors, and where such a system is lacking the annual report reveals it unmistakably.

Secondly, the yearly report has been found an invaluable aid to enforcement by helping to form intelligent public opinion. We are dealing here with a public office—the activity of public officials, peculiarly dependent upon the approval of the community for effective work. In communities

where people in general are interested and alert as to the welfare of working people, the laws tend to get enforced with a minimum of friction and a maximum of efficiency. It follows that publicity is one of the important weapons of efficient administration. We are not proposing that law and enforcement should wait upon the vagaries of public opinion. Public opinion is often unintelligent and reactionary, and the labor laws should be just far enough in advance of it to force up the standards of the backward and unenlightened employers. But all that makes for a wider general knowledge of the facts at issue—industrial conditions, working hours, work accidents, and the like—helps to form that enlightened public opinion without which labor laws, in a democracy, cannot in the long run be enforced.

Thirdly, the yearly factory reports have been found not only efficient aids to the administration of existing laws, but perhaps the most valuable means of securing better laws. As we have seen, successive factory laws have not been based upon theories or generalities but for the most part have followed some insistent demand for the correction of specific abuses. Abroad, the factory inspectors have been in a position to furnish such facts to legislative bodies. They have made available a fund of information gained from official investigations and experiences.

We have seen that since 1833, when the first English inspectors were appointed and were charged to report on the condition of the workers and the operation of the laws, a more or less continuous record of industrial history has come down to us. What record of industrial conditions and of the operation of our factory laws do our American factory reports yield, or will they leave to posterity?

Let any student who wishes to form an opinion on this subject read a year's files of American factory reports. It will not be possible to read a current year's file, for many of the states do not publish current reports, although their value for remedial action depends upon the freshness and genuineness of the information they furnish. By the time

our state factory reports have been printed, the information contained therein is often several years old. For instance, in 1909, the latest available Illinois report was for 1905. The report of the Massachusetts state inspectors of health for the year ending November 1, 1908, was published at the close of 1910. Eight states publish biennial reports and their news is inevitably one year late.

It is true that these delays in printing are not, in the first instance, due to the inspection force. The chief inspector or head of the labor department shifts the blame for the delay on to the state printer. Yet this delay is essentially an index of the efficiency of the labor department, and it has been shown that if sufficient pressure is brought to bear, these reports can be issued in time. This was illustrated in New York state in 1905, when an efficient commissioner of labor determined that his report should be published at the close of the year which it purported to describe. His report and recommendations to the legislature were accordingly issued on time, while the tables and statistical portions of the department's work were necessarily delayed until later. This procedure has ever since been followed in New York state, whose reports in substance, as well as time of issuance, differ commendably from most other publications of the state labor departments.

The belated publication of the American factory reports obviously destroys the three-fold function which, as we have pointed out, they should fulfill: revealing the internal organization of the inspection department, forming public opinion, and furnishing material for constructive legislation.

Moreover, the contents of these reports are, for the most part, little calculated to accomplish these purposes. No report is efficient which does not tell *at least* the following elementary facts concerning the workers:

(1) The number and occupations of men, women, boys, and girls found at work.

(2) The ages of the minors, the issuance of "working papers," and other data relating specifically to the employment of children.

(3) The times, places, and nature of violations of the law.

(4) The methods of dealing with such violations by warnings, prosecutions, or the like.

(5) The number and disposition of prosecutions actually brought to court, including the amount of money collected in fines and penalties.

(6) The nature of occupations deemed dangerous to health, the number of workers found therein, and (as far as possible) the effects of the work.

All these things must be known in order to gauge the effectiveness of the laws, and the points in which they are adequate or inadequate. Yet few state reports contain such accurate, specific, and current information. The opinions of the inspectors, for instance, on the value and workability of their respective state laws are almost totally lacking.

Only a few years ago a striking exhibition was given, not alone of the extraordinary ignorance of the chief labor official of a great state, but also of his open animus against the labor laws which he was appointed to enforce. The report of the Pennsylvania chief factory inspector for the year 1907 appeared in 1908, the year in which the United States Supreme Court rendered its famous decision in the Oregon ten-hour case, upholding the right of a state to protect its working women by limiting their hours of labor.* Shortly before that decisive judgment was to be handed down, the chief factory inspector of Pennsylvania officially declared his hostility to a similar Pennsylvania law, on the ground that it was, in his opinion, unconstitutional. "I have yet to find a single instance," he takes pains specifically to write,† "where any court of last resort has upheld" such a statute—ignorant of four earlier decisions upholding the constitutionality of

* For a full discussion of this decision see Chapter IX, page 250.

† Report of the Pennsylvania Chief Factory Inspector, 1907, pp. 10 and 11.

similar laws by the Supreme Courts of four other states, Massachusetts, Nebraska, Washington, and Oregon! The impropriety of such an official attack upon the Pennsylvania law was the more glaring because an earlier Pennsylvania act limiting women's hours of labor had been previously upheld in a strong and illuminating decision by the Superior Court of Pennsylvania.*

Owing to conditions of which the foregoing is an extreme example it has come about at any time of need that, instead of the responsible officials, private investigation, without proper powers, opportunities, or privileges of observation, has had to furnish facts and figures about labor conditions.

Thus, since the first permanent child labor committee was formed in New York City in 1903, the entire American campaign against child labor has been hampered by having to depend almost wholly upon private investigation of the facts, to secure laws protecting children from premature work. In state after state private investigators have had to learn the extent of child labor, the conditions under which children have been employed, the effects of premature work upon health and morals and industry—all those facts which the official inspectors should have been publishing as the bases of legislation. Not until the first volume of the federal investigation of working women and children was published in 1910, was there any comprehensive study of the children employed in the cotton mills. Moreover, the facts and statistics gathered by private investigation are often considered open to the charge of personal bias. Government investigation is impersonal; its reports carry greater weight because they are held to present wholly uncolored facts.

* Commonwealth v. Beatty. 15 Pa. Sup. Ct. 5, 15.

(b) The Observation of Health in Industrial Establishments

A second almost universal failure in administering labor laws concerns the observation of the health of working people, as affected by their occupations. The whole justification, legal and moral, of laws such as those limiting the hours of labor, prohibiting the employment of women and minors in certain occupations, providing sanitary regulations, seats for girls and women, and the like, is their necessity for the health and welfare of the workers. Yet so elementary has been our conception of administering these health statutes, that we have practically not yet begun to test the value of medical inspection of work places. It is true that the labor laws have not required the appointment of physicians as inspectors, except in a few instances which we will next discuss. But the lack of the most rudimentary observation of the health of the workers is a legitimate reproach to every labor department which makes any pretense of inspection.

A beginning has been made in New York state to cope with the difficult problems affecting health in industrial occupations by the appointment of one physician to act as inspector. During his first years in office the medical inspector has had to specialize chiefly on the single subject of ventilation and the obscurer pollutions of the atmosphere in factories and stores.

In Massachusetts, too, an attempt has been made to provide medical observation of the workers. In 1907 the office of state inspector of health was created under the Massachusetts state board of health, and 15 such inspectors were appointed. Besides other duties they are required to enforce various sanitary and hygienic regulations in factories, to inform themselves as to the health of minors in factories and the prevalence of tuberculosis and other diseases amongst factory workers.

Thanks to a careful and detailed system of record keeping, the reports of the Massachusetts inspectors of health, together with a previous investigation by the state board of

health, have given the first official American returns on many unhealthful processes of manufacture.*

One of the most important duties of the Massachusetts inspectors of health has been to assist the state board of health in enforcing the new and epoch-making law of 1910 concerning the employment of minors. This provides for the exclusion of minors under the age of eighteen years from any occupation or process of manufacture deemed by the board sufficiently injurious to health. Accordingly, many processes have been studied with a view to determining their effects upon young persons. For example, the manufacture of rubber goods was specially scrutinized, and some stages of the work were found unfit for minors. In rubberized clothing factories, the medical inspectors found young boys employed at work which required them to spend from one-third to one-half of their entire working time in doubled-up positions crawling underneath the "spreader" machines, breathing over-heated air vitiated by naphtha fumes. Their heads were protected from the heat of the machines by planks covered with asbestos.

Following these and similar reports from the inspectors of health, regarding the injurious nature of many different kinds of manufacture, the state board of health issued an order on July 10, 1911, declaring 24 different processes of manufacture to be injurious to the health of minors, within the meaning of the law. These processes involved exposure to poisonous or irritating dust, gases, and fumes, and the employment of minors under eighteen years of age was accordingly forbidden therein. This included such work as

* Memorial on Occupational Diseases prepared by a Committee of Experts and presented to the President of the United States, September 29, 1910. *American Labor Legislation Review*, Jan., 1911, p. 137.

Report of the Massachusetts State Board of Health upon the Sanitary Conditions of Factories, Workshops, and other establishments where persons are employed. 1907.

Report on the Work of the State Inspectors of Health Nov. 1, 1907, to Nov. 1, 1908. From the 40th Annual Report of the Massachusetts State Board of Health.

Ibid. Nov. 1, 1908, to Nov. 1, 1909. From the 41st Annual Report of the Massachusetts State Board of Health.

that of the "spreader boys" in the rubberized clothing factories.

Another valuable service performed by the medical inspectors was inaugurated in Worcester. Beginning with one public spirited employer, the medical inspector has secured the co-operation of numerous others in combatting the growth of tuberculosis among their employes, by paying their expenses at the state sanatorium for a shorter or longer period.*

These initial services suggest how great a part the medical inspector may fill in helping to prevent deterioration of health among factory workers. But in many most important respects the Massachusetts system has been no test whatever of medical inspection. The inspectors of health are paid to give only part time to this work; many at the same time continue private practice as physicians. They have so much more work assigned to them than they can perform that in January, 1911, some medical inspectors appointed in 1907 had not yet completed a tour of their districts.†

The so-called examination of children employed in factories is especially inadequate. For instance, from among 43,270 working children reported as "inspected" during the year 1907–1908, only 521 were found ill or physically unfit for the work they were performing. This surprising percentage (scarcely more than one-tenth of 1 per cent) is explained by the method of "inspecting" minors. One inspector, for instance, reported:

> "A total of 4,881 minors were examined. Of this number, 706 were inspected without conversing with them, while passing through the factory."‡

* Up to April, 1911, 34 industrial establishments signified in writing their willingness to take part in this campaign. Twenty-seven employes in all have been aided. See Bulletin of the United States Bureau of Labor, No. 96, Sept., 1911, p. 488. Hanson, Wm. C., M.D.: Attitude of Massachusetts Manufacturers Toward the Health of Their Employes.

† Report of the Commission to Investigate Inspection of Factories, Workshops, Mercantile Establishments and other buildings. Boston, January, 1911, p. 60.

‡ Report of the Work of the State Inspectors of Health, Boston, 1907, p. 86.

Efforts have recently been made to obtain places within the factory for more adequate examinations.

Moreover, the inspectors of health have nothing whatever to do with the enforcement of that statute which our study has shown to be perhaps most important: the law which protects the workers against industrial fatigue by limiting their working hours. When the office of inspector of health was created in 1907 to enforce sanitary regulations, the enforcement of all other factory laws, including the limitation of the hours of labor, was left as before to the factory inspection department of the Massachusetts district police. No co-operation has existed between the two departments. The commission appointed in 1910 to investigate the inspection of factories, etc., found that:

"The two groups of inspectors go their separate ways without assisting each other at all in the enforcement of the laws."

"The factory inspectors and the health inspectors in the same district as a rule never meet each other. Many inspectors testified to this fact before the Commission. Some of these inspectors assigned to the same district actually met for the first time at the Commission's hearing."*

Thus the appointment of physicians as additional inspectors of factories in Massachusetts has hitherto been a tentative experiment—valuable chiefly in demonstrating the wide possibilities of medical inspection.

6. SOME TECHNICAL REQUIREMENTS IN FACTORY INSPECTION

But the character of administration and inspection is receiving a new attention in many quarters. It has long been a matter of common knowledge that, in general, the caliber of the men and women who administer the labor laws in the

* Report of the Commission to Investigate Inspection of Factories, etc. Op. cit., pp. 57 and 67.

United States has been utterly inadequate for their duties. Until 1911 only three states—Massachusetts, New York, and Wisconsin—required inspectors to pass civil service examinations before appointment, and by an extraordinary exemption Massachusetts obliged preference to be given to Civil War veterans, without examination, as inspectors of the district police. This exemption is no longer observed, but in December, 1910, the veterans still numbered 12 out of 28 factory and building inspectors.*

In place of the most elementary technical fitness, chiefs of departments as well as subordinates have, for the most part, been appointed for political or personal reasons. Hence, the first needs are to make all appointments to the inspection service subject to civil service examinations of the proper character, and to assure tenure of office during good conduct, instead of allowing inspectors to be displaced at any moment by political favoritism. Other urgent needs, to improve the service, are to pay more adequate salaries than the present ones; to grade inspectors according to their ability and to promote them for good service—a system which has been begun with good effects in New York state. Such and similar changes would tend towards securing a more valuable class of inspectors.

There is ground for encouragement in the yearly increasing number of men and women of higher caliber who are becoming available for an improved service. The social aspects of labor and labor legislation newly studied in colleges and universities throughout the country, have turned the attention of many young men and women to the possibilities in this field. Special schools in New York, Boston, Chicago, Philadelphia, and St. Louis are training students each year for social work, who should be available for administrative positions in the service of the state as they are for private societies. But we need even more than this. We need inspectors equipped with technical training.

* In 1911, New Jersey enacted a law requiring civil service examinations for inspectors.

At the opposite pole from our disorganized and untrained system we find such an extremely elaborate service as that in Prussia, where there has been a regular program of training since 1897. Members of the staff, which numbers over 270, are appointed for life. They must have three years of technical study in such subjects as mechanics, mining, or chemistry, and a year and a half of probationary practice in the service. This period is followed by one and one-half years of university study in law and political science, and a written and oral examination in Berlin by an examining board instituted for this special purpose.*

Such extreme requirements are cited here merely by way of contrast. They do not appear as yet to have resulted in an ideal enforcement of labor laws in Germany, and they would clearly be impossible in this country. But it is becoming more evident each year that our service is in urgent need of inspectors of special knowledge and training.

No one but a physician can study the manifold relations of industries to health, and inspect working people (adults as well as minors) in order to learn the physical effects of industrial fatigue, dangerous occupations, unsanitary conditions and the like. The federal report on the white lead industry in the United States shows that dangerous processes regulated abroad are not only unregulated here but so carried on as to be "much more dangerous" to health than they are in Europe.† In such occupations a special limitation of working hours is called for, as well as sanitary requirements. We have seen that the most eminent physicians in Canada were opposed to more than six hours' work each day for girls in the exacting telephone service. In Germany today adult men are prohibited from being worked more than two hours at a stretch in certain dangerous processes,

* Bulletin of the United States Bureau of Labor, No. 89. July, 1910. Veditz, C. W. A., Ph.D.: Child Labor Legislation in Europe, p. 192.

† Bulletin of the United States Bureau of Labor, No. 95. July, 1911. Hamilton, Alice, M.A., M.D.: White Lead Industry in the United States, p. 190.

such as filling and emptying oxidizing chambers in lead works.*

This is indeed the prime value of the medical inspection of work places: to check industrial disease *at its source*. It not only removes to tuberculosis sanitaria and the like, workers who have acquired disease at their occupations, but it performs a more constructive service. It discovers the causes of industrial infection or overstrain in the dusty and poisonous and straining processes of manufacture; and the improvement of such conditions is more important than the cure of the sick. It protects the workers *before* they have been injuriously affected. Within the next decade scientific study should show the dangers of occupations peculiar to our country and modes of manufacture, and should indicate in what occupations the day's work must be radically reduced to conserve the workers.

Beside such medical study of industry we need other technical study as well. The ventilation and lighting of workrooms, guarding of dangerous machinery, and the forced removal of the noxious by-products of manufacture, are engineering problems directly related to the health of working people. They have hitherto been left almost wholly to the discretion of untrained lay inspectors. As might have been expected, little progress has been made in their solution. But at least these things have come to be recognized, even in America, as unsolved problems for professional study and investigation. Fixed standards of safety, sanitation, ventilation, and lighting have not yet been agreed upon, but will be perfected during the next few years, and will assist greatly in the effective protection of working people.

It is in this connection that profound interest attaches to the new scheme of administration recently devised by the state of Wisconsin. In 1911 an industrial commission was created which superseded all the former machinery of ins pec

* Bulletin of the United States Bureau of Labor, No. 95, p. 170. Factory Regulations of the Chancellor of the German Empire Regarding Lead and its Products.

tion and enforcement. It consists of three members, appointed for periods of six years each by the governor of the state. The novelty of this commission lies in its extraordinary range of power. It is not only charged to administer and enforce a list of specified statutes, such as the laws relating to child labor and school attendance, women's employment, laundries, bakeries, fire-escapes, and the like. In addition, the commission is practically enjoined to see to it that all work places shall be safe and sanitary. It is specifically empowered to ascertain, fix, and enforce standard safety devices, and all other means of protection for the "life, health, safety, and welfare" of employes in all places of employment.

No charter could be wider than this. Under its provisions the commission may appoint not only the lay factory inspectors, but experts of every technical description, to adopt and modify standards of safety commensurate with the ever changing mechanisms and processes of industry.

Such a sweeping and almost revolutionary scheme of administration obviously carries with it potentialities of abuse as well as of extraordinary value. The very breadth and looseness of the powers conferred makes their effectiveness peculiarly dependent upon the spirit which informs them. The present personnel of the commission encourages the most hopeful auguries.* But time alone can show whether, under the Wisconsin scheme, the routine difficulties of the subordinate inspectors will be lessened or increased in enforcing the standards, and in withstanding the pressure of employers for concessions and modifications in the name of their "practical needs."

However that may be, and whatever the value of leaving free and unfixed the standards of sanitation and safety, so far as concerns our special subject (the curtailment of industrial fatigue by the limitation of working hours) we need rigid statutes precisely for the sake of that enforcement which is their raison d'être. If the experience of England and

* Prof. J. A. Crownhart, chairman, Prof. John R. Commons, Mr. J. D. Beck.

Massachusetts has proved anything, it has proved that rigid laws limiting the workday have been enforceable, and that the lax laws have not.

Even when trades are differentiated and varying hours of labor must be fixed according to their degrees of injuriousness to health, such special regulations should be as nearly fixed and definite as can be settled by legislation.

Here, however, the question arises as to the rights of legislatures. Under their constitutional powers, how free are they to enact measures limiting the length of the workday? To answer this, we must next consider some recent decisions of the courts on the scope of labor legislation.

IX

LABOR LAWS AND THE COURTS

IN any discussion of the laws which limit an adult's hours of labor, we must constantly bear in mind the fact that no law is final in the United States until it has passed the review of the courts. Physicians may agree as to the urgency of curtailing the workday, legislators may enact such statutes in deference to a public demand, but unless the judges are convinced of their harmony with the federal and state constitutions, such laws are declared unconstitutional and are void.

At first sight, the question of constitutionality appears to be remote from the course of our discussion, a region of legal technicalities and abstractions into which the layman may scarcely venture, and in which such human forces as hygiene and social welfare must count as nil. But in fact the reverse is true. In the last resort, the constitutionality of these laws is determined by no other considerations than such medical and social facts as those which we have discussed at length.

1. THE POLICE POWER

In order fully to understand this relation, we must keep in remembrance the old truth that government, indeed society itself under any form of government, means restraints of one kind or another. By the inexorable law of compensation, so soon as men join in any bonds of union, they must surrender some portion of their individual liberties in return for the solidarity which protects them. The state's right to impose such restraints or regulations upon the individual is called the police power. Under this power, all our laws for the

protection of health, safety, and welfare have been enacted and sustained by the courts; laws such as the quarantine and liquor laws, those establishing hospitals and insane asylums, laws which require fire-escapes in hotels, schools, and factories, the fencing of dangerous machinery, and a host of others.

The police power is thus of widest application and has no definite limitations. Its applications have been repeatedly defined by the courts in a very large number of cases. "From the mass of decisions," says Professor Freund, one of the foremost writers on this subject, "it is possible to evolve at least two main attributes or characteristics which differentiate the police power; it aims directly to secure and promote the public welfare, and it does so by restraint and compulsion."*

Hence, in reviewing legislation the courts must decide whether any specific statute is justifiable in order to preserve the public health, safety, and welfare, or whether it infringes unduly upon personal liberties. Here we reach the core of our difficulty and the obstacle which has stood in the path of labor legislation.

2. THE "FREEDOM OF CONTRACT" THEORY

It is a fact of common knowledge that after our civil war, the fourteenth amendment of the Federal Constitution was adopted, and similar provisions in the state constitutions, declaring that "no state shall deprive any person of life, liberty, or property without due process of law."

By one of life's ironies, this wellknown phrase has been interpreted by the courts as prohibiting the protection of working people in sundry ways, on the ground that their individual rights are interfered with. Labor is property, said the judges. The laborer has the same right to sell his labor and to contract with his employer as any other property owner. Hence the laws limiting hours of labor, or regulating

* Freund, Ernst: The Police Power, p. 3. Chicago, Callaghan and Co., 1904.

labor in other ways, are in conflict with the fourteenth amendment, because they interfere with the laborer's individual property rights.

This theory of the so-called "freedom of contract" was not invoked against labor legislation until twenty years after the fourteenth amendment had been adopted for a very different purpose. In 1886, the Supreme Courts of Illinois and Pennsylvania first threw out certain labor cases as unconstitutional on this ground.*

The "freedom of contract" assumption has so vitally affected the very existence of the laws in which we are concerned, that we may well glance at the six or seven most important decisions of superior courts on the subject, handed down during the last sixteen years, between 1895 and 1911.

The fallacy of this thesis has been of late so much discussed that it need not delay us long. It is coming to be recognized that since employes do not stand upon an equality in bargaining power with their employers, the so-called "right" to contract for a day of any length is purely theoretical. The worker in fact obeys the compulsion of circumstance. No one can suppose that young women working in the box factories of Chicago, discussed in a previous chapter, need or desire to be protected in their "right" to labor overtime nine months in the year; or that women in laundries should be "free" to work fourteen hours or more during several days of the week. They have, in fact, no choice or freedom in the matter. The alternative is to work or starve. To refuse means to be dismissed. Modern industry has reduced "freedom of contract" to a paper privilege, a mere figure of rhetoric.

The First Ritchie Case. Yet this was precisely the ground upon which the judges of the Illinois Supreme Court in 1895 declared invalid an Illinois eight-hour law for women employed in factories. In what is known as the first Ritchie

* Freund, Ernst: Constitutional Limitations and Labor Legislation pp. 51–71. Address before the Third Annual Meeting of the American Association for Labor Legislation, New York, December, 1909.

case,* they declared that the police power of the state did not sanction such an interference with the working hours of adult women. There was no "fair, just, and reasonable connection between such limitation and the public health, safety, or welfare proposed to be secured by it." Hence the law was declared unconstitutional; and for thirteen years, until this decision was practically over-ruled by the United States Supreme Court in 1908, it retarded the movement for the protection of working women in all our states.

The Case of Holden v. Hardy. Curiously enough, three years after the decision in the Ritchie case, a law limiting men's hours of labor was carried to the federal Supreme Court at Washington and was sustained.† This case involved the validity of the Utah law fixing an eight-hour day for men employed in mines and smelters. The court handed down a decision which has become almost a classic in its clear statement of the broad principles at issue. It is true that the employments regulated were clearly dangerous to health, safety, and welfare. Therefore the limitation of hours was more obviously justifiable under the police power. Indeed, the court based its favorable decision on the fact that work in mines and smelters was not like ordinary employment, but that the operative was

"'. . . deprived of fresh air and sunlight and is subject to the foul atmosphere and a very high temperature, or to the influence of noxious gases."

But the judges dealt not only with the hazards of these employments. They struck a loftier note which rises clear and strong above the technical argument. They were preoccupied with something larger than the single law in dispute. It was the state which figured before them—a congregate whole which was only as great as "the sum of all its parts." These parts, they said in stirring words, did not

* Ritchie v. People, 155 Ill. 98 (1895).
† Holden v. Hardy, 169 U. S. 366 (1898).

stand upon an equality with one another in the economic scale, and therein lay both the need and the justification of the state's intervention.

"But the fact that both parties are of full age, and competent to contract, does not necessarily deprive the state of the power to interfere, where the parties do not stand upon an equality, or where the public health demands that one party to the contract shall be protected against himself. The state still retains an interest in his welfare, however reckless he may be. The whole is no greater than the sum of all the parts, and when the individual health, safety, and welfare are sacrificed or neglected, the state must suffer."

It is significant, as the court pointed out also in this decision, that such cases as the one at bar have not been brought by working people eager to secure their "right" to labor any number of hours, but by the employers to whose advantage it is for them so to labor. "The argument," said the court, "would certainly come with better grace and better cogency from the other class."

These two decisions, then, set forth clearly the issue between personal liberty and the police power. In the Ritchie decision the judges set a theoretical freedom above concrete realities. In Holden v. Hardy the law appeared to be justified by its necessity.

The Lochner Case. The next case to be considered is the only other one in which the United States Supreme Court has rendered an opinion as to the validity of a law limiting the hours of adult men in private employment.* This was the New York law for bakers, restricting the hours of labor in bakeries to ten hours in one day, or sixty hours in one week, overtime being allowed for the purpose of shortening the last day of the week. In 1901 the law was attacked as unconstitutional by a master baker. It was sustained by the New York courts and then appealed to the

* Lochner v. New York, 198 U. S. 45 (1905).

Supreme Court at Washington which declared it unconstitutional.

Here we have the same court which upheld the validity of the Utah law dismissing the New York law as one of the "mere meddlesome interferences with the rights of the individual."

Where the Utah decision took a firm stand in behalf of those who did not "stand upon an equality," the decision in the Lochner case repudiates the idea that bakers are in any sense wards of the state.* The judges were again, as in the earlier Illinois case, unable to see any connection between the proposed limitation of hours and the public health and welfare. Bakeries, unlike mines and smelters, did not seem to them dangerous *enough* to regulate. Doubtless it will be genuinely surprising in the future to reflect that, in this significant case, a majority of the United States Supreme Court could find no "reasonable ground" to justify the New York bakers' law. A majority opinion of the New York Court of Appeals had dwelt upon the dangers to health arising from excessive hours in the heated, dust-laden atmosphere of the bakeries. A concurring opinion had cited medical authorities at length to show the unhealthful nature of such hours of work. Yet the reaction is more apparent than real. In substance the Lochner decision does not over-rule the court's previous sanction of the Utah law. The way was still left open for the justification of other laws limiting the workday, if the judges could be shown "that there is material danger to the public health, or to the health of the employe, if the hours of labor are not curtailed."

The Williams Case and its Challenge. Unfortunately, in the next decision we are to examine, legal technicalities again predominated in the minds of the judges over the

* In a valuable article on Legislative Restriction of Hours of Labor, Bulletin of the New York Labor Department, No. 46, March, 1911, John A. Fitch draws attention to the fact that it was Judge Peckham, who had dissented from the opinion of the court in Holden v. Hardy, who wrote the opinion in Lochner v. New York.

simple facts of industrial life, of which they were evidently unaware. Two years after the bakers' law had been upheld by New York's highest court, the same bench, in the Williams case, declared invalid a law prohibiting the employment of women in factories between 9 p. m. and 6 a. m.* This case was of deep significance for the cause of women. It was the first, and is the only decision by any court, which deals with women's night work. As we have seen, there were in 1907 only four state laws existent on the subject.† For our country has lagged conspicuously behind the rest of the world in seeking to control night work, the form of labor most fraught with possibilities of injury to the human frame, particularly to the health of women. Yet the New York Court of Appeals deliberately ignored all the broader implications of the case; all those intricate social aspects of night work, its effects upon health and the home and general welfare, which European statesmen had been studying for years, and which had culminated in the Berne International Convention on Night Work eight months previous to the Williams case—all these wider issues were not even touched upon. We seek in vain for that freer air of statesmanship and understanding which breathes from the decision of Holden v. Hardy. In the Williams case the court deliberately limited itself to considering "solely" whether work at 10:20 p. m. (as in the case at bar) was injurious enough to warrant interference with women's "freedom of contract." They were genuinely concerned because, under the existing law, no woman could be employed within the prohibited hours for any period of time "*no matter how short.*"‡

But the real issue did not center on this single narrow aspect of the matter. It stands to reason that work at 10:20 p. m. is not in itself inherently injurious. But night work, *as it exists in reality*, does not consist of such isolated theoretical employment. As we have seen, it means, in

* People v. Williams, 189 N. Y. 131 (1907).

† In New York, Massachusetts, Nebraska, and Indiana.

‡ Italics added.

practice, either overtime work prolonged into the evening after and in addition to the normal day, or employment on continuous night shifts. Both these forms of night work the judges in the Williams case expressly deplored; but in their anxiety to preserve women's "freedom" to work a theoretical short period after 9 p. m., on the assumption that such work was neither long nor overtime, they opened the way for precisely the evils which they themselves condemned! And we have had, in consequence, such formidable examples of night work as in the binderies running twenty-four hours at a stretch, quoted in a previous chapter. These have been the direct results, the corollaries of the Williams decision.

Now the writer of that decision had gone so far as to state specifically: "I find nothing in the language of the section which suggests the purpose of promoting health except as it might be inferred that for a woman to work during the forbidden hours of the night would be unhealthful." Here was an explicit challenge thrown down by the learned writer of this opinion. If, indeed, the language of the law contained nothing which suggested to the court the purpose of promoting health, clearly that purpose should have been made clear, beyond the shadow of a doubt, in the law's defense.

In defending the cases which we have reviewed up to this point, the arguments and citations of the lawyers had been almost wholly confined to the purely legal aspects of those actions. Briefs of counsel had discussed in infinite detail the power. But the point at issue had in fact wholly shifted from relation between the fourteenth amendment and the police the state's abstract right to restrict individual rights, to the practical necessity for every such restriction. The question was no longer abstract and legal, but rather in a deep sense social and medical. It followed that the purely legal defense of these laws was falling wide of the mark. It had long been unreasonable to expect that judges, trained in schools remote from factories and workshops, should be conversant with those underlying practices and conditions

which alone could justly weight the scales. The men upon the bench needed for their guidance the empirical testimony of the working woman's physician, the factory inspector, and the economist. They needed, in a word, to know the facts.

For some years previous to the Williams decision, many persons interested in labor legislation, and particularly the Consumers' League, had been following in detail the influence of successive court decisions.* In an earlier case, involving the validity of certain sections of the New York child labor law,† the writer of these pages had been called upon to furnish the presiding judge with testimony from the New York Factory Inspectors' reports, relative to the social value of such legislation.

Before the Williams case had been carried to the New York Court of Appeals,‡ the writer had made an effort to obtain some expressions of opinion from physicians, on the subject of women's employment at night, comparable with the findings of European physicians. It was hoped that some prominent medical men in New York might be induced to state their views of the physical injuries incident to industrial night work, just as in 1892 a group of distinguished and public-spirited British physicians had presented to Parliament a memorial on the injuries from overlong hours in shops, in support of Sir John Lubbock's Early Closing Bill.§

But from among ten prominent New York physicians who were approached, only two were willing to express themselves publicly. One of these was a physician grown old in

* See Kelley, Florence: Some Ethical Gains Through Legislation. New York, Macmillan, 1905. Goldmark, Josephine: The Necessary Sequel of Child Labor Laws, *Amer. Jour. of Sociology*, pp. 312–325. Nov., 1905; Workingwomen and the Laws. *Annals of the American Academy of Political and Social Science*, pp. 261–276. Sept., 1906.

† The City of New York v. Chelsea Jute Mills. 43 Misc. 266. (1904).

‡ The law had been declared unconstitutional by the Appellate Division of the New York Supreme Court, two out of five judges dissenting.

§ British Sessional Papers, 1892. Vol. XII, p. 238. Among the signers of the memorial are such wellknown names as Sir Andrew Clark, Sir Richard Quain, and 298 others. See Part II of this volume, p. 515.

service whose life-long practice had made him as familiar with the dire effects of industrial overwork as of excessive idleness. The other was a younger man whose active part in the tuberculosis campaign had brought forcibly to his notice some of the contributory causes of overstrain among working people. The striking fact in the refusal of the other physicians to share in any arraignment of the night shift or late overtime work for women, was their general remoteness from the common facts of what seemed almost like a different order of existence. The speed, the strain, and the long hours of factory life belonged to a chapter of human life wholly outside of their own crowded and specialized lives. Not one of them raised the objection that a public expression of medical opinions might be construed as an attempt to prejudice the case. They were unacquainted with the facts at first hand and, indeed, for the most part, doubted their existence.

This modest attempt, then, failed. But when, in 1907, the decision of the Court of Appeals in the Williams case explicitly stated the court's inability to see the purpose of the law, it became more than ever apparent that a new emphasis was needed in the defense of labor legislation, and we awaited the opportunity in which to put this belief into practice.

The Oregon Case and a New Line of Defense. Such an opportunity offered in the very same year. A laundryman was arrested for violation of the Oregon law fixing a ten-hour day for women employed in factories and laundries. The validity of the law was affirmed by the Oregon courts, and in December, 1907, an appeal was taken to the United States Supreme Court at Washington. Here, then, was an opportunity to present the real issue to the highest court in the land, concerned for the first time in its history with a statute limiting the workday of adult women. By good fortune, the active interest of a distinguished lawyer*

* Mr. Louis D. Brandeis of Boston, who has given his invaluable services unpaid in these cases.

was enlisted and he proposed to put these issues before the court in a new way. His argument and brief marked a radical departure in the defense of labor laws. It confined itself to the tangible human elements involved—health, welfare, and economic efficiency.*

In a brief of more than 100 pages, he devoted two to the legal aspects of the case, and over 100 to a new kind of testimony—mankind's experience, physical and moral, with respect to women in industry and the duration of their working hours. The document was made up from the accumulated mass of British and Continental factory inspectors' reports, commissions and *enquêtes*, as well as the observations of medical men and economists. It was well received by the court, which in its decision upheld the validity of the Oregon law. Quoting from the new empirical evidence contained in the brief, the court stated that it "took judicial cognizance of all matters of general knowledge," thus in a single phrase warranting the new emphasis upon practical data.†

The decision in the Oregon case was indeed no narrow victory. It was the most sweeping decision ever rendered by the federal Supreme Court in relation to working hours. It was not confined to the consideration of the ten-hour day or to a working day of any particular length. It left to the states the liberty to determine what working hours were wholesome and reasonable. It went far beyond the statute at issue, which dealt with the employment of women in factories and laundries, and looked towards the protection of women in other employments. In a word, the highest court of the nation rejected the fiction of the free contract as regards the working woman and declared that "her physical nature and the evil effects of overwork upon her and her future children justify legislation to protect her from the greed as well as the passion of men." The new method of defense had amply justified itself.

* Supreme Court of the United States, October Term, 1907. Curt Muller v. the State of Oregon. Brief and Argument for Defendant by Louis D. Brandeis and Josephine Goldmark.

† See Part II, p. 558.

THE SECOND RITCHIE CASE. It was again to be put into practice and again to be justified in the following year (1909), immediately after the auspicious Oregon decision had in principle reversed the earlier Ritchie decision of the Illinois Supreme Court. The way was now open for laws protecting women from overwork, and many states enacted such legislation. Among others, the Illinois legislature of 1909 provided a ten-hour day for women employed in laundries and factories. Hence, fourteen years after the first Ritchie decision, a new law was carried up to the Illinois Supreme Court for its adjudication.*

A wholly new bench of judges were sitting in the case. The widespread public curiosity throughout Illinois as to the outcome of this case, bore witness to a new recognition of the large issues at stake, not only to women in industry, but to the state. The court in sustaining the ten-hour law was not deterred as the same court had been fourteen years before by the freedom of contract theory. All that body of "general knowledge" which the federal judges had taken into cognizance, was again admitted to carry its due weight. In a single illuminating sentence the Illinois court also responded to the new emphasis upon the substantial and substantiated facts, remarking, "what we know as men we cannot profess to be ignorant of as judges."

3. THE DISTINCTIONS OF SEX

Now among these facts known to all men and presented to the court, were the ill effects of industrial speeding, strain, and the like, upon working women, *qua* women. Their physical organization, the greater morbidity of working women compared with men in the same occupations, and the dependence of future generations upon the health of women, all had been dwelt upon to justify the legal restriction of their hours. This was because the earlier decisions, overthrowing the validity of women's labor laws, had denied any

* Ritchie & Co. v. Wayman, 244 Ill. 509 (1910).

special protection to women "on the mere fact of sex." Women were citizens, hence their contractual powers could not be disturbed. Indeed the New York Court of Appeals went so far as to say in the face of civilized precedent, that "an adult woman is not to be regarded . . . in any other light than the man is regarded, when the question relates to the business pursuit, or calling."

This specious argument and the alleged impossibility of differentiating between men and women was, indeed, long an obstacle in the way of securing women's laws. Thus in England between 1874 and 1901 the factory acts were in the main opposed by an important wing of the women's rights party. Superficially viewed, the great movement to obtain for women, in all fields, rights from which they have been debarred, might appear inconsistent with the effort to protect one sex as contrasted with the other. But this is a fundamental misconception. It ignores the fact that protection of health has never been held a bar to the efficiency of men as citizens.

It has yet to be suggested, for instance, that the miners of 13 states—Arizona, California, Colorado, Idaho, Maryland, Missouri, Montana, Nevada, Oregon, Oklahoma, Utah, Washington, and Wyoming—are discriminated against, because the state restricts their working hours to eight in one day* for the explicit purpose of protecting the health of its citizens. It has yet to be suggested that the interstate railroad telegraphers are less valuable as citizens than any other men because Congress, in 1907, restricted their work to thirteen hours by day and nine hours by night. This statute and similar restrictions in many states were enacted nominally to safeguard the traveling public. But its only excuse for being is the effect of excessive hours upon the operative's efficiency. These restrictions upon men's working hours have never interfered with their value or dignity as citizens. Why then, should similar restrictions—

* Ten hours in one day in Maryland, applying to Allegany and Garrett counties.

wider and more inclusive for women—operate against their dignity or value as citizens? Their physical endowments and special functions make the protection of their health even more necessary than the protection of men's health; they need even more than men the legislative protection which, as Justice Brewer said in the Oregon case, "is designed to compensate for some of the burdens which rest upon" them.

It is true that, as we have seen, the restriction of men's hours of labor has been upheld by the courts only when the occupations sought to be regulated are manifestly dangerous to health, such as mines and smelters, or where public safety is directly concerned, as in railroading. Yet in so far as prohibition of excessive hours for men has been justified by dangers resulting to their health and efficiency, the argument for more inclusive women's laws is precisely similar.

Fortunately this view has on the whole prevailed in the United States, and the steadily growing equal suffrage societies have taken a logical stand in defense of the state's responsibilities towards working people, be they men or women.

Why, indeed, should these measures, justifiable on the broad ground of health and welfare, be in the future limited to women? The New York State Department of Labor has recently published a thoughtful review of judicial decisions dealing with the hours of labor of adult men.* The writer, John A. Fitch, has brought together the most important conservative dicta of the courts (typified by the Lochner decision overthrowing the bakers' law) and their most progressive utterances.† He concludes that while the judiciary

* Bulletin of New York State Department of Labor, No. 46. March, 1911, p. 90.

† Of such progressive utterances none are more striking than the two following paragraphs, taken, respectively, from decisions of the New York Court of Appeals and of the Superior Court of Pennsylvania:

"In the interest of public health, of public morals and of public order, a state may restrain and forbid what would otherwise be the right of a private citizen. . . . It may limit the hours of employment of adults in unhealthy work, and *it may be that it could prohibit the performance of excessive physical labor in all callings.*" (People v. Orange County Road Construction Co., 175 N. Y., 84, 87.) Italics added.

is, as a whole, on the side of conservatism, the advanced sentiments found in sundry decisions indicate "conditions other than stationary."

In upholding the validity of many Sunday laws, the courts have repeatedly declared that the cessation of labor one day in seven is essential for health, morals, and general welfare. It has not yet been made manifest to the judges that an adequate *daily* period of rest for men is as essential as the *weekly* rest period. The question arises whether laws limiting men's hours of labor might not have a more favorable outlook for being sustained by the courts "if an effort were made similar to the effort in the Oregon and Illinois women's cases, to present evidence with respect to long hours of work in industries where men are employed." Could not such evidence readily be found to justify laws prohibiting the twelve-hour shifts in continuous industries, and requiring the employment of three shifts instead of two? The outrageous duration of work in continuous industries * and the brutalizing effects of the twelve-hour day and eighty-four-hour week would make this perhaps the most timely legislation for men. Some laws embodying these principles already exist. In Montana and Pennsylvania there are eight-hour laws for hoisting engineers, in mines operated sixteen hours or more a day; and the federal law has already been referred to, which provides for interstate telegraphers a thirteen hour day in offices open only by day and a nine-hour period in offices open both day and night.

"A prohibition upon unhealthy practices, whether inherently so, or such as may become so by reason of prolonged and exacting physical exertion which is likely to result in enfeebled or diseased bodies, and thereby directly or consequently affecting the health, safety, or morals of the community, cannot, in any just sense, be deemed a taking or an appropriation of property.

"The length of time a laborer shall be subject to the exhaustive exertion or physical labor is as clearly within legislative control as is the government inspection of boilers, machinery, etc., to avoid accidents, or of the sanitary conditions of factories and the like to preserve the health of laborers." (Commonwealth v. Beatty, 15 Pa. Sup. Ct., 5, 15.)

* See p. 4.

4. THE QUESTION OF DISCRIMINATION

One further point regarding the validity of these laws needs comment in this brief chronicle. This concerns another section of the fourteenth amendment, declaring that no state shall "deny to any person within its jurisdiction equal protection of the laws." Under this, or similar provisions in state constitutions, laws regulating conditions of labor have been declared invalid, as discriminating improperly between persons or classes, thus denying equal protection of the laws.

Now it must be remembered that in their review of legislation, it is the function of the courts to determine whether the legislature had any reasonable grounds for its action; not whether the laws as enacted are inherently and in themselves good or bad, but whether the legislature was justified in its conclusions, as embodied in the laws.

Obviously, in enacting any laws limiting hours of labor, the legislature must use its discretion in choosing among various alternatives, such as the number of hours to be fixed, the persons to be protected, and other similar points. Opponents of these laws have usually raised the contention that they were unfairly discriminatory, because certain persons or classes of persons were included or left out.

In the Ritchie case, for instance, it was claimed that the law was unfair "class" legislation because it included women working in factories and laundries and not in other occupations. In a more recent case involving the Michigan ten-hour law for women* the law was attacked as "class" legislation because a different class of workers were omitted. In both these cases the courts performed a great service by upholding and reasserting the freedom of the legislatures to use their discretion as to the scope of the laws. "If all laws were held unconstitutional because they did not embrace all persons," said the Illinois court (quoting another decision), "few would stand the test." In each case the court concluded

* Withey v. Bloem, 163 Mich. 419. (1911).

that the law was not "class" legislation, although it did single out those workers who seemed to the legislature most in need of protection. The Michigan court again throws the responsibility for the scope of the law squarely upon the discretion of the legislature, quoting with approval from Cooley's Constitutional Limitations on this point, "the legislature must judge." The law cannot be called unconstitutional because "it does not apply to all callings."

This emphasis upon the freedom of the legislature should be welcome to all lovers of democracy, even though legislatures, like all human agencies, may err and prove false to their trust.

In point of fact, the Michigan ten-hour law which was sustained by the Michigan Supreme Court contains a thoroughly vicious section. It excludes from the protection of the law all women "engaged in preserving perishable goods in fruit and vegetable canning establishments." This exception was a weak concession to a powerful interest, a yielding to undue pressure. Yet only a doctrine of despair would welcome the correction of such legislative failures through the agency of the courts. The remedy lies not in destroying the legislative functions and handing over to the courts a wider jurisdiction than is their right. It lies in raising the caliber of legislators and in bringing to bear upon the legislatures the power of new ideas, which, in the long run, never fails. For this we need, primarily, a wider study and knowledge of those fundamental truths which are the bases of our protective legislation, and which these chapters have sought briefly to set forth.

X

PROHIBITION OF WOMEN'S NIGHT WORK: A PRIME NECESSITY

1. THE INTERNATIONAL CONVENTION ON NIGHT WORK

AS we have seen, in June, 1907, the New York Court of Appeals by a unanimous decision struck from the statute books of New York the law against women's night work, one of the four state laws on the subject at that date existent.* Just eight months before, in Berne, Switzerland, there had been held a memorable meeting, attended by official delegates from 14 European nations. This was the result of a quarter century's effort, a new move in labor legislation: an international convention of the Powers. The subject of the treaty chosen, according to Professor Raoul Jay, as one of the most urgent, most important, and most easily solved of labor problems, was the abolition of women's night work.

These official acts, falling within the same twelve months at opposite poles from one another, are significant of the diametrically opposed mental attitudes prevalent in the United States and in Europe, toward the same phenomenon.

Yet the employment of women at night is not one of the subjects legitimately differentiated in a democracy and under other forms of government. As we have trod the same path as our elder kin abroad in other legislation reducing the length of the workday, we shall sooner or later find ourselves obliged to follow their action in regard to the employment of women at night. But whereas abroad the prohibition of

* These states were Massachusetts, New York, Indiana, and Nebraska. A New Jersey statute enacted in 1892 which prohibited the employment of women in factories between 6 p. m. and 7 a. m. was held repealed by a general repealing act of 1904.

women's night work has gone hand in hand with the reduction of the day's work, and a legal closing hour has been found an integral part of effective laws, this issue has been for the most part ignored in the United States. The lack of a legal closing hour has hampered the law enforcement in all but three of our states.

We have seen that England prohibited night work in her first factory legislation for women in 1844. Almost a generation passed before any other European state took action. In 1864, the Swiss canton of Glaris followed England's example and forbade the employment of women at night in factories. Ten years later a declaration in the Swiss federal constitution authorized the regulation of the hours of labor of all adults. The Swiss federal law of 1877 which followed, contained a clause prohibiting women's night work. Many attempts were made later, from time to time, to obtain overtime privileges for various industries, but, wrote the eminent Swiss factory inspector Fridolin Schuler twenty-five years later, "no one ever dared to suggest the repeal of the night work law." (Ces dispositions protectrices n'ont jamais été touchées . . . personne n'osa s'attaquer au travail de nuit.)*

The prohibition of women's night work had been introduced by the same F. Schuler in 1887 to a wider audience, at the International Congress of Hygiene and Demography at Vienna. This is a body of scientists to whose work we have previously referred, who have met at regular intervals abroad, and during the past twenty years have been devoting their attention more and more to the problems of industry as well as of pure science.†

* Le Travail de Nuit des Femmes dans l'Industrie. Rapports sur son importance et sa réglementation légale. Préface par Prof. Étienne Bauer, Directeur de l'Office Internat. du Travail. Pp. 343–344. Jena, Fischer, 1903. This book contains the investigations made by the International Association for Labor Legislation into the physical, moral, and economic aspects of night work. It has been taken as a basis for this chapter.

† In this connection interest attaches to the first meeting of this Congress in the United States, which is to take place in Washington, D. C., September, 1912.

The next important body to discuss the employment of women at night was the famous International Conference on Labor called by the German Emperor, to the astonishment of Europe, in March, 1890. The Swiss federal government had been promoting international labor agreements during the eighties, and had arranged a conference to be held in Berne in May, 1890, when the Kaiser issued his rescript calling a conference in Berlin two months earlier.* The rescript was in some respects so radical that to many persons it stood for "state socialism"—a deliberate move to forestall the socialist advance. Whatever its underlying objects, the Berlin Conference resulted in no binding agreements, but among its resolutions concerning the employment of women and children, the prohibition of night work was recommended.†

During the next ten years the subject was discussed by other international meetings, and finally the International Association for Labor Legislation at its first meeting of delegates in 1901, determined to investigate the whole field: the extent and effects of women's night work in the various countries, and the actual economic results of prohibiting night work by law. A year later, following this investigation, the association appointed a commission to devise means of obtaining a general international prohibition of women's night work, and the gradual reduction of evening overtime exemptions. (Le Comité national charge une commission de rechercher les moyens d'introduire cette interdiction générale, et d'examiner comment les exceptions qui existent encore à cette interdiction pourraient être progressivement supprimées.)‡

After a year's deliberation, the commission recommended that the Federal Council of Switzerland be asked to initiate

* Hutchins and Harrison, op. cit., p. 270.

† Seven states voted affirmatively on this question: Germany, Austria, Great Britain, The Netherlands, Sweden, and Switzerland. Five states voted in the negative: Hungary, Belgium, Spain, Italy, and Portugal. Three states refused to vote: Denmark, France, and Norway.

‡ Bauer: Preface to Le Travail de Nuit des Femmes dans l'Industrie, op. cit., p. x.

an international convention forbidding women's night work in industry. The commission recommended also that a memorial be sent to all the powers, setting forth the reasons for desiring such an international convention, which should assure to women who work outside of their own homes an unbroken period of twelve hours' rest at night, certain trades and processes being exempted.

Both of these recommendations were carried out. In response to the invitation of the Swiss Federal Council there assembled at Berne, September 26, 1906, representatives of 14 European powers: Austro-Hungary, Belgium, Denmark, France, Germany, Great Britain, Italy, Luxemburg, Portugal, Spain, Sweden, Switzerland, and the Netherlands.

An international agreement was submitted to the Conference. It bound the contracting states to prohibit the industrial night work of women without distinction of age. The agreement applied to all industrial establishments employing more than 10 persons. A minimum period of eleven consecutive hours was set for the duration of the night rest, to include the time between 10 p. m. and 5 a. m. in all cases. In states where such legislation had not previously existed, the period of uninterrupted night rest might be temporarily reduced to ten instead of eleven hours, during a period of three years.*

Only two exceptions permitting night work were provided. First, in case of "force majeure," or the interruption of work by causes beyond the employer's control, often known as the "Act of God"; second, to save raw material or material in course of manufacture, liable to rapid deterioration. No other concessions were made to the seasonal industries, ever insistent for special privilege. They were not exempted from the prohibition of night work. A slight modification in their favor was permission to reduce the length of the night rest from eleven to ten hours during sixty days in the year.

*The line dividing industry from commerce and agriculture was left for each country to define.

The participating states were required to ratify this convention, to file their ratifications with the Swiss Federal Council within a specified time, and to adopt administrative measures for carrying out the terms of the agreement. It was to go into effect two years after ratification.

By January 14, 1910, all the participating states, excepting Spain and Denmark, had ratified the convention.* In accordance with a special article, the French government had notified the Swiss Council that the terms of the agreement were accepted for Algiers and Tunis. Similar notice was given by the British government for Gibraltar, the Gold Coast, North Nigeria, Uganda, Ceylon, New Zealand, Fiji Islands, Leeward Islands, and Trinidad.† Comic as it may appear at this date to legislate for the South Seas and for the Africa of romance and adventure, yet bitter experience has taught the wisdom of so legislating before industry is present.‡

Moreover, the night work treaty must be regarded as an instrument of value far beyond its own intrinsic worth. It marks a new era in labor legislation. For the first time the powers have treated on a plane with staples of commercial value, as legitimate subjects of international agreement and treaty, such hitherto neglected assets as the health and welfare of wage-earners.

The effect of the treaty in modifying previous laws may be illustrated by some of the amendments of the German Industrial Code in 1908, seventeen years after the first effective German law governing women's hours of labor had been enacted in 1891, following the International Conference of 1890. This first law had copied the British model in prohibiting work at night between specified hours, as well as prohibiting more

* Bulletin of the International Labour Office. English edition. Vol. I, 1906, p. 272. The original limit set for the ratifications was December 31, 1908; postponed to January 14, 1910.

Additional leeway of ten years before enforcement is granted the following industries: first, the manufacture of unrefined beet sugar; second, woolcombing and weaving; third, open mining operations when climatic conditions stop operations at least four months in the year.

† Ibid., Vol. VI, 1911, p. 11.

‡ Bills are pending in Spain and Denmark (March, 1912).

than a specified number of hours by day. The employment of women was forbidden between 8:30 p. m. and 5:30 a. m. and after 5:30 p. m. on Saturdays and days preceding holidays. By the amendment of December, 1908,* among other changes, the period of night rest was lengthened one hour, work being prohibited from 8 p. m. to 6 a. m. and after 5 p. m. on Saturdays. At the termination of the workday, an uninterrupted period of at least eleven hours of rest was required.

Such are the general provisions. Many exemptions for overtime may be granted, for various reasons and varying lengths of time, by the German Federal Council and by the higher or lower administrative authorities. But the amendment of 1908 reduced the range of many of these exemptions, and required the establishment of a closing hour in cases where it had not previously been required.

Thus one section of the complex German Code gives special powers to the Federal Council in regard to women's hours of labor. For instance, in industries where there is seasonal pressure of work the Federal Council may grant exemptions forty times during the year, but the daily period of work must not exceed twelve hours nor eight hours on Saturday.

Previous to 1908 there was no fixed closing hour for such exemptions. The amendment of that year specified that the period of rest following the workday must amount to at least ten consecutive hours and must include the time between 10 p. m. and 5 a. m.†

Again, in cases of exceptional accumulation of work, overtime may be granted by the lower and higher administrative authorities a fixed number of times during the year. Previous to 1908 such overtime was allowed until 10 p. m. and a workday of thirteen hours was permitted. The amend-

* German Industrial Code, Section 137. Bulletin of the International Labour Office. English edition, 1908, p. 335.

† German Industrial Code, Section 139 a. Bulletin of the International Labour Office. English edition, 1908, pp. 337 and 338.

ment of 1908 limited such overtime to twelve hours in the day, changing the closing hour from 10 to 9 p. m., and required that the daily period of rest must be not less than ten hours.*

2. THE CASE AGAINST NIGHT WORK ABROAD

The investigations which preceded the Berne Convention dealt with the physical, economic, and administrative aspects of night work. The employment of women at night was scrutinized by physicians, economists, and specialists in labor enforcement, and was found in the first place unmistakably dangerous to health. For all night work, whether it be carried on regularly in night shifts or irregularly in the evenings, has certain characteristic and unavoidable effects. Of these the most obvious are the loss of sleep and sunlight, and the hygienic argument against night work centers upon the inevitable physiological deficits due to this lack of sleep and sunlight.

We have seen, in a previous chapter, that during work the chemical products of activity increase. The internal combustion is more active. In the famous experiment of the physiologists Voit and Pettenkoffer, a man was shown to expire almost twice as much carbon dioxide during a day of work as during a day of rest. But during rest at night the processes of tissue repair are in the ascendant. This is one of the reasons why loss of sleep is so detrimental to the organism. This is also the reason why all forms of night work, inevitably resulting in loss of sleep, are in the long run bound to be injurious.

Besides loss of sleep and rest, another characteristic of both night work and evening overtime is the loss of sunlight. Sunlight appears to benefit all our bodily functions. It stimulates growth and assists in the elimination of toxic wastes. Loss of sunlight therefore reacts disastrously. Animal experimentation shows that the blood of animals

* Ibid., p. 336.

kept in the dark suffers a loss of the red coloring matter. Investigation among night workers also shows the ill effects resulting from the lack of sunshine in impoverished blood: the term "baker's anæmia" tells its own story.*

More than twenty years ago the German factory inspectors found a marked excess of illness among night workers, as compared with day workers in similar occupations, even though the hours of labor at night were shorter than by day.† The French commission of 1890, which investigated the industrial employment of girls and women in France before the first effective French law of 1892, reported especially on the injuries to childbirth, and the high infant mortality among women employed on night shifts.‡ Physicians as well as factory inspectors of all nations agree that after a shorter or longer period, women habitually employed at night suffer from all those symptoms which betoken lowered vitality: loss of appetite, headache, anæmia, and weakness of the female functions.

Dr. L. Carozzi, in a more recent limited but intensive study of night workers in an Italian spinning mill, bears out the testimony of earlier investigators. The night workers whom he examined all showed marked signs of anæmia and general debility. He found among them a "continual sense of fatigue, of heaviness, breakage, of exhaustion—in a word a sense of chronic tire, which weighs upon the workers and undermines their lives."§

The injury to health from night work is the greater be-

* Wiener klinisch-therapeutische Wochenschrift. Vol. XIII. Nr. 27, 1906. Gardenghi, Dr. G. F. (Director of the Institute of Hygiene, Parma): Veränderungen des Blutes durch Nacht Arbeit.

Ibid., No. 28, 1906.

Proceedings of the First International Congress on Industrial Diseases. Milan, June, 1906. Bolettino, Dr. L. (Lecco): Sull' Influenza della Luce Naturale nel Lavoro, p. 100.

† Amtliche Mittheilungen aus den Jahres-Berichten der mit Beaufsichtigung der Fabriken Betrauten Beamten, 1889, p. 93.

‡ Documents Parlementaires. Chambre des Députés, 10 Juin, 1890. Annexe 649. Waddington, M. R.: Rapport fait sur le travail des enfants, des filles mineures, et des femmes, etc., p. 1088.

§ Carozzi, Dr. Luigi: I Danni del Lavoro Notturno. Lavoro. Vol. III. Milan, 1905.

cause sleep lost at night by wage-earners can rarely be made good in the daytime. In the first place, for reasons not well understood, sleep in the daytime appears to be generally less restorative than by night. It is less potent to accomplish its office of repair and refreshment.

But even if day sleep could habitually compensate for the inversion of nature's order, it is not within the wage-earner's reach. Quiet and privacy for sleep by day are unattainable luxuries. Upon returning home in the middle of the night or at dawn, the workers can snatch at most a few insufficient hours of rest. Women who work at night fare particularly ill. Those who are married cannot postpone the regular household necessities which await them in the morning, such as cooking breakfast, dressing and caring for the children, and the like. Unmarried women, too, whether they live at home or are thrown upon their own resources, can rarely avoid a certain amount of household work, which combines with the lack of quiet to make impossible adequate sleep by day after night work.

In thus destroying home life, night work militates against morals as well as against health. Clearly, no form of women's work so interferes with their domestic relations as enforced absence from home in the evenings, the only time when wage-earning families are together. Young women who work at night are deprived of all the restraining influences of home life. When the mother of a family spends the night or evening in work, disorder is almost unavoidable, and the comfort of the men as well as of the children dependent upon her ministrations, is lost.

These, then, were some of the hygienic and moral objections to night work found in actual experience abroad. The advocates for prohibition next examined its economic value. They found a consensus of opinion that wherever night work had been abolished long enough for industry to adjust itself to the change, prosperity had not suffered. This was because, in a word, night work is inferior to day work. Output deteriorates in both quality and quantity. Defects

occur more easily at night, and more easily escape detection. In weaving and in industries where colors must be distinguished, work by artificial light is never satisfactory. The profits of plants running uninterruptedly day and night are reduced by the wear and tear on equipment and the increased running expenses. But chief of all, they are reduced by the impaired efficiency of the workers. Just as after a limited period of overtime, efficiency steadily declines, so after night work the workers tend to deteriorate. Many mill owners stated to the investigators who preceded the Berne Convention that in the long run night work had proved financially unsuccessful.

Hence, as we have seen, the margins of overtime have been gradually reduced, and the laws against night work, first bitterly opposed in most countries, are being gradually accepted. The Dutch factory inspector's account of the gradual acceptance of the night-work law by the proprietors of the laundries in Holland is especially interesting.* A tempest of indignation was aroused, wrote T. H. Van Thienen, by the Dutch law of 1889, which prohibited work after 7 p. m. in laundries using motor power. It was called, as all regulation is first called, the ruin of the industry (la ruine de leur profession). To abandon the traditional modes of work, to change the hours of the arrival and delivery of linen, to interfere with the workers' irregular habits (l'habitude de se lever tard et de se mettre tard à l'ouvrage)—all this aroused the resentment of employers, accustomed to keep their establishments open until late at night. But, according to Van Thienen, most of these fears were imaginary (n'existaient que dans l'imagination), and proved to be groundless when work was reorganized so as to end at 7 p. m. as required by the statute. He reported that the law still needed careful watching (une surveillance rigoureuse) in 1903, twelve years after it had been enacted, but concluded that the results of prohibiting night work had been "extremely favorable."

*Le Travail de Nuit des Femmes dans l'Industrie. Op. cit., p. 304 ff.

This account is typical of the evidence as to the operation of night-work prohibitions, contained in the official reports of the International Labour Office. The evidence all tended to prove that the prohibition of night work, like the reduction of day work, was in the long run a benefit to industry. It contributed to raise the efficiency both of the management and of the employes.

3. NIGHT WORK IN THE UNITED STATES

In contrast now to the Berne Convention of 1906 and the legislation of European states bringing their laws into conformity with its terms, the status of women's night work in the United States is a cause for deep concern.

We have seen that the New York Court of Appeals failed to apprehend its true significance. But more unfortunate than this decision (for there is good reason to believe that the court might take a different view if the real issues were more clearly brought to its attention)—more unfortunate than the court's decision, is the widespread public indifference in regard to the practice of working women at night.

The United States was not able to take part officially in the Berne Convention, since the federal government cannot bind the individual states to enact legislation restricting hours of labor. But far from aiming at the same goal,—prohibition of night work, of their own initiative,—American states are drifting in a precisely opposite direction.

While all the civilized (and some uncivilized) nations of the world are abolishing work at night, and cutting down the margins of overtime, American states are for the first time granting special overtime privileges to one great industry—canning—and are deliberately recognizing the employment of women on night shifts. The legislature of the enlightened state of Wisconsin in 1911 enacted its first effective law limiting the working hours of adult women,* and in the same

* The early Wisconsin law of 1867 was not enforceable, since it prescribed a penalty only for employers who *compelled* women to work more than ten hours in one day.

statute it legalized an eight-hour night shift for women between 8 p. m. and 6 a. m. This provision requires that work at night be two hours less than the legal day's work, but it is none the less true that this law specifically authorizes the employment of women during that period of the night set apart by the Berne Convention as a minimum time for rest.

Connecticut passed a law similar to that of Wisconsin in 1908, and bills containing similar provisions were introduced in Maryland and New Jersey in 1912.* No other states have specifically legalized night work for women, but such work is permissible, because not prohibited, in *all other American states* excepting three—Massachusetts, Indiana, and Nebraska.

The forces which make for night work,—accepting the enactment of such legislation as in Wisconsin, defeating bills aimed to prohibit night work in other states,—may be gauged by their activities during the sessions of 1911.

Legislatures sat in 40 states. In most of these states some bill was introduced affecting women's conditions of labor. So unpopular and so little regarded was the prohibition of night work that in only two states—Delaware and New Jersey—besides the District of Columbia, were attempts made to include a legal closing hour in the proposed legislation. These three bills all failed to become laws,† and while this fact is not in itself conclusive,—for many bills failed in other states,—it is significant that these bills had admittedly no chance of passage until the closing hour had been eliminated.

In Delaware, for instance, the original bill prohibited all night work after 10 p. m. After many deliberations and efforts at persuasion the bill emerged from conference, shorn almost beyond recognition. The following places of employment had been specially allowed to employ women without restraint at night: laundries, canneries, the telephone service, restaurants, candy stores, ice cream saloons, and

* Enacted in Maryland, March, 1912.

† The Delaware bill was passed with amendments, but Gov. Pennewill failed to sign it.

stores between December 11th and 25th—all those places in which the employment of women at night is an entrenched custom. Where night work is not customary or is not at present needed, its prohibition was not opposed.

Thus the special interests which desire to employ women at night are awake and untiring; public appreciation of the issue is dead or not yet born. Hence, in the United States today, legislation restraining employers from requiring women to work at night is the most difficult to secure, though the reduction of the day's work gains ground each year.

So little has the subject been regarded that we do not even know the extent of this dangerous form of employment, sprung up almost like the armies of Cadmus, overnight. We do know that the custom of evening overtime, extending to late evening hours, is prevalent in most industries to a degree unsuspected by most persons.

Reference has already been made to the appalling duration of night work found by the federal investigators in a very limited study of binderies in New York City. Of 13 women who worked on night shifts in such establishments, the hours of four girls are specifically stated. They were employed respectively 16¾, 20¼, 22½ and 24¼ hours once and sometimes twice a week, during a long period of the year, that is, from four to almost seven months. The girl whose record of hours was most appalling worked 24¼ hours twice in 21 weeks. Her usual long day was 20¼ hours.*

Official reports of the outrageous duration of night work in laundries are also available. An inquiry into the causes of a strike of laundry employes in New York City was conducted in February, 1912, by the Bureau of Arbitration of the New York State Department of Labor. At public hearings, employes testified under oath as to their hours of labor. It appeared that work until 1 a. m. was on occasions not unknown, and that work until midnight was more often found to exist.

* Report on Condition of Woman and Child Wage-Earners in the United States. Vol. V, p. 205. Senate Document No. 645, 61st Congress, 2d Session, 1911.

The three following schedules of "long weeks" reported in the stenographic minutes of evidence,* though they need not be regarded as typical, illustrate to what extremes the night work of women in laundries is carried, when there is no legal closing hour for work.

SOME INSTANCES OF EXTREMELY LONG HOURS IN NEW YORK LAUNDRIES

Day of week	*Woman who has worked 2 years in laundries*	*Woman who has worked 6 years in laundries*	*Woman who has worked 11 years in laundries*
	A.M. P.M.	A.M. P.M.	A.M. P.M.
Monday	12 – 12	12 – 12	? – 9[a]
Tuesday	9 – 11:30	9 – 11:30	9 – 11
Wednesday	9 – 9:30	9 – 9	9 – 8
Thursday	9 – 7	9 – 7	9 – 7:30
Friday	9 – 6:30	9 – 6	9 – 6
Saturday			

[a] Sometimes until 10 p. m. or later. Latest 1 a. m.

We know also that in one great occupation—the telephone service—a host of girls and women are regularly employed at night and all night, where only a few years ago the night service was performed by men and boys. It is true that the telephone companies find it necessary to make better provision for the comfort and safety of their night workers than other employers. Rest rooms are provided, and the night shift is not exposed to the objectionable late return home, being kept on duty almost invariably from 10 p. m. to 5 or 6 o'clock in the morning. But the fundamental physiological objections to night work remain the same: the workers' lack of sleep and sunlight; their inability to make up adequate sleep by day. The shifting army of "telephone girls" keeps changing; often the service holds them

* Not yet published at date of writing. Reproduced by courtesy of the New York Commissioner of Labor.

less than two years, a trade life of extraordinary brevity*; and no one is the wiser as to the effects upon them of this exacting occupation, of which night work is a regular incident.

The recent federal investigation of wage-earning women and children gives little more than sidelights and hints as to the extent and effects of employment at night. But even these scattered data are all in accord with the facts as to health, morals, and efficiency found earlier by the European investigators.

In the investigation of the cotton textile industry, mills were found operating at night in North and South Carolina.† According to the Census ‡ there were, in 1908, 293 cotton mills in North Carolina; 59 of these were covered by the investigation. Thirty-one mills operated by night, not counting two which had discontinued night shifts during the year. The number of women and children under sixteen years employed on night shifts was 848, nearly equalling the number of men, 874, employed at night. In South Carolina, the investigation covered 36 of the existing 150 cotton mills. Five mills were found operating at night; 188 women and children under sixteen years were employed, and 155 men.

The agents of the government visited workers who were employed in North Carolina cotton mills during the twelve hours from six in the evening until six in the morning. At eleven o'clock in the morning they were sitting drowsily over scant fires, too listless to seek sleep. When they did lie down, the inevitable noises in thinly partitioned wooden houses, where every sound can be heard from room to room, made sound sleep impossible. "Usually they arose at four

* The Railroad Commission of Wisconsin found that in seven large exchanges of the Wisconsin Telephone Co. in Milwaukee, 290 operators were employed on Jan. 15, 1907, with 22.72 months' average length of service; on Jan. 15, 1908, 407 operators were employed with 18.52 months' average length of service. Senate Document No. 390. Investigation of Telephone Companies, p. 51.

† Report on Condition of Woman and Child Wage-Earners in the United States, Vol. I, Cotton Textile Industry, p. 284. Senate Document No. 645, 61st Congress, 2d Session, 1910.

‡ Census Bulletin No. 97, 1908, p. 10.

or five in the afternoon and again took their seats before the fire, too weary and sluggish to think of a walk in the open air."*

Shocking abuses were found by the investigation, in connection with night work in two small mills in North Carolina. While these cases are not cited as typical, they are given "to show the extremes to which unregulated labor of women and children can go in the absence of legal regulation or of efficient means of enforcement."†

In one of these mills it was common for night workers who had worked all Friday night to continue until 3:30 o'clock on Saturday afternoon, "working approximately twenty and one-half out of twenty-one and one-half consecutive hours." The day workers were "frequently requested to return to the mill immediately after supper and work until midnight, and frequently some one was sent to the homes of employes early in the evening or at midnight to request day workers to come and work half the night. Some employes usually declined to do overtime work. Others worked alternate nights as a regular custom."

Among those who thus worked at night after and in addition to a twelve-hour day, was a family of five children, consisting of three boys, aged ten, fifteen and seventeen years, and two little girls of eleven and thirteen years. Their names were entered upon both the day roll and the night roll of the mill.

"It was found," says the report, "that during a considerable part of the eight months that this family had been at this mill, these children had worked two or three half nights each week, in addition to day work. After working from 6 a. m. to 6 p. m. with 35 minutes for dinner, they had returned to the mill usually every other night immediately after supper, and worked until midnight, when they went home for four or five hours of sleep before beginning the next day's work; or, they had been aroused at midnight and sent to the mill for the second half of the night, where they

*Senate Document, No. 645, Op. cit. Vol. I, p. 289.

† Ibid. Vol. I, pp. 290–291.

remained until six o'clock the following afternoon, except when eating breakfast and dinner. In either case, they were on duty for a working day of seventeen hours, with no rest period save for meals. Those who worked the second half of the night went home for a hurried breakfast just before 6 a. m.

"The father of the family was apparently an active, hardworking man. He expressed the opinion that night work in addition to day work was rather hard on the children, but said that he was trying to get money to buy a home. . . . No member of this family could read or write."

The government agents found the homes of many night workers as dismal and neglected as similar homes were found by investigators abroad. In several cases when both parents worked on night shifts, the children came to the mill to sleep on boxes and rolls of cotton,—pitiable drifts and strays deprived of anchorage.* Or when the mother of a family worked on a night shift and also attended to her home duties, including the weekly washing and ironing, she had to spend "one day at least . . . from 18 to 24 hours without sleeping."

Of the moral degeneration due to night work, the government report on the glass industry gives lurid instances.† Women's work in glass making is confined for the most part to the finishing department and to the lehr-room, where glassware is removed from the lehr or annealing-oven in which it has been slowly cooled after firing. In four factories, however, negro women are employed as substitutes for boys in the furnace rooms. Here, during the night shift and at dawn when work stops, are found at their worst the coarseness and immoralities resulting from the close association at night, of men and women hardened by the most exhausting and hottest labor.

If the character of these poor negro women in the glasshouses be held responsible for the excesses of the night shift and the perils of their lonely return home, what shall be said

* Ibid. Vol. I, pp. 289 and 293.

† Ibid. Vol. III. The Glass Industry, p. 177 ff.

of the similar perils and alarms of refined women employed in night restaurants, whose return home at midnight or thereabouts is compulsory? Can there be any doubt that such a necessity is unworthy of any community calling itself civilized?*

Such, then, are some of the documentary evidences, though insufficient and merely suggestive of the existing night work of women. If we turn now to our fragmentary data as to the economic value of night work, it seems also to corroborate European experience. Just as the silk mill owners of the Vosges and Rhône found weaving by artificial light unsatisfactory, so it is beginning to be found in the silk centers of America.† Just as night work was abandoned by many European employers because of its lesser productivity and the decreased efficiency of their workers, so, says a recent publication of the South Carolina Department of Agriculture, Commerce and Immigration, night work "seems to be generally regarded as a losing proposition."‡

Cotton mill owners in North Carolina who had voluntarily discontinued night work and were therefore disinterested witnesses, were unanimous in declaring to the government investigators that

"it did not pay. They asserted that, as a rule, they could induce only an inferior class of employes to work on the night shifts, with a constant lowering in the quality of product, while at the same time a higher rate of wages than usual was required to secure even this class of help; that continuous operation resulted in more than ordinary 'wear and tear' on machinery, and that there was a disposition to neglect the care of machinery when used jointly by two shifts. The manager of a mill in Georgia, which had carried on night work for a year and abandoned it, expressed the feeling tersely by saying, 'It was hard on the people and hard on the machinery.'" §

* Ibid. Vol. V. Wage-Earning Women in Stores and Factories, p. 75.

† Ibid. Vol. IV. The Silk Industry, p. 143.

‡ The Cotton Mills of South Carolina. Published by the South Carolina Department of Agriculture, Commerce, and Immigration. 1907.

§ Senate Document No. 645. Op. cit., Vol. I, p. 285.

"The indications," says the federal report, "are strong enough to warrant the conclusion that overtime runs to dangerous limits in both mercantile and manufacturing establishments, in the absence of restrictive laws not only setting definitely a limit to the hours of labor per day and per week, but *fixing the closing hours.*"*

The legal closing hour which has been found the only practicable device to check unscrupulous night work, is the most immediate need in our legislation for working women. It must be made an integral part of all laws reducing the length of the workday if they are to be enforceable and if they are to protect the workers in fact as well as in theory.

The special interests are strong enough today to obscure the issues and secure for themselves special license to invert nature's order of life for thousands of working women. Nature's revenges for the infraction of her inviolable law will teach another generation better wisdom, unless reason can in our day prevail over indifference and greed, and restore to wage-earning girls and women the night for sleep.

* Senate Document No. 645. Op. cit., Vol. V. Wage-Earning Women in Stores and Factories, p. 215. Italics added.

XI

CONCLUSION

MANY persons who have followed our argument to this point may be inclined to resent the predominating rôle assigned to overwork and fatigue. They may contend that this stress on the length of working hours is wholly irrational; that overstrain is altogether too limited a cause to assign for the breakdown of health and efficiency. "The really fundamental basis of health," these critics will say, "is contingent upon the total standard of living. The causes of breakdown cannot be isolated, but lie in the total disabilities of working people. Their dark and unsanitary homes, their overcrowding and lack of privacies, their bad food and unpalatable cooking,—all these things are more important for health than the mere number of hours spent at work. And on the industrial side, probably wages and income have a much more direct relation to health than a few hours more or less of work. In curtailing work, therefore," our critic continues, "you are further lessening productivity and income, and so are merely making the struggle for existence harder."

Some conscientious critics go even further than this and contend that leisure is mere temptation to go wrong, when people live in wretched, crowded homes, with only the street and the saloon to satisfy desire. A shortened workday, they say, gives the workers just so much more opportunity for dissipation.

Now it is, in large degree, this point of view on the part of many persons which is responsible for much of the prevalent indifference and ignorance concerning the active injuries of overwork, in industry as it exists today.

In a previous chapter we have dwelt upon the economic fallacy in this criticism, and have shown how output and wages tend to rise rather than fall with shortened working hours, so that income is in the long run increased, not curtailed.

So far as regards temperance and the whole general tone of working communities, we need not rely on theories and speculations. We need only appeal to that body of historical fact to which we have so often turned for light. As a matter of fact, what has been the effect on working people of increased leisure? How have they, on the whole, spent the added hour or hours of freedom from work?

The answer to this question is, indeed, one of the most encouraging chapters in industrial history: the response to opportunity, the rapidity with which working people have learned the uses of leisure. Where cynics prophesied mere drunken idleness and rowdyism, fairer observers found a kind of regeneration. There was no sudden millennium but wherever sufficient time has elapsed since the establishment of a more humane workday, allowing a wider margin of leisure, the workers have made extraordinary advance in physique and morals.* The gradual emergence of the English mill operatives from the physical and moral degeneration into which they had sunk in the thirties of the last century, is not exceptional but typical.† It is a humble chronicle, but full of meaning to any reader who loves the fullness of human nature. Gardening, sewing, the out-of-doors on summer evenings, evening schools in winter, time for the "endearing trivialities of home life,"—these were some of the simple, yet enduring things at which mill workers learned to spend their leisure.

Of the benefits accruing from the change, none have been greater than the increase in temperance. Nor is this surprising. No thoughtful observer can seriously ascribe to

* See Part II of this volume, pp. 290–317.

† British Sessional Papers, 1847–48, Vol. XXVI, p. 9; 1849, Vol. XXII, p. 7; 1850, Vol. XXIII, pp. 48–49; 1868–69, Vol. XIV, p. 83, etc.

man's natural depravity, the domination of liquor with all its attendant miseries. The truth is that among industrial workers the desire for drink has often sprung from sheer physical exhaustion. To a wholly unappreciated extent the sway of alcohol has been due to the worker's craving for some stimulant or support for exhausted energies.

Thus, for instance, in such places of work as the laundries, which make the heaviest demands on muscular and nervous strength, where hours are long and overtime lasts late into the night, drink is the resource of physical debility.

Sir Thomas Oliver, the eminent English expert on industrial diseases, dwells* upon this condition of affairs in England, and the same may be observed in our own country.

"Imagine the amazement of the master of a mill or weaving factory if his employes were to stop in a body for a quarter of an hour twice a day between meals to drink beer! Yet in many laundries the beer is kept on the premises for the purpose. . . . A woman who is expected on Thursdays or Fridays to be in the laundry from 8 or 8:30 in the morning till 9 or 10 or 11 at night, may claim with some show of reason that only by some kind of spur can she keep her overtired body from flagging."

On the other hand, by releasing the workers before the very exhaustion of fatigue overtakes them and inclines them to the strong stimulant of drink, the shorter workday has been a powerful influence toward greater sobriety and self-control.

No thinking person can deny that in the last resort health is determined by the total standard of living; that—besides long hours—poverty and low wages, unsanitary tenements and bad food, dirt and overcrowding, are the tangled causes of lowered vitality and illness. Nor would we minimize the physical effects of mental distress and worry among working people who are only a few months off from real destitution, when a short loss of employment may mean starvation.

* Oliver, Thomas: Dangerous Trades, p. 672. New York, E. P. Dutton and Co. London, J. Murray, 1902.

We would freely grant all that our critics can possibly say of these evils. They cannot be too strongly stated. Yet, so far as the overworked are concerned, all these causes of distress might be removed—wages, food, housing, and sanitation, all be raised to a higher level—and yet the essential cause of breakdown would be untouched so long as the "few extra hours of work" remain, as our supposed critics would call them. The shorter workday and relief from overstrain are not in themselves the cure for the ills we have considered; but they are the *sine qua non* without which no other cure is possible or conceivable. Just because a fatigued person is a poisoned person, poisoned by the accumulation of his own waste products, nothing can fundamentally cure the exhausted worker which does not eliminate the cause of such accumulated poisoning. As we have seen, after exhaustion has set in nothing but rest and repose permits the organism to expel its poisons from day to day.

In Professor Lee's impressive words:

"Mankind at present can administer no food or drug that can push the wearied cells up the metabolic grade either simultaneously with their descent or quickly after the descent has ceased. Only the assimilation and detoxication that normally come with rest, and best, rest with sleep, are capable of adequate restoration of working power."*

It would be no more unreasonable to expect to cure a lead or arsenic-poisoned worker by higher wages, good food, and a clean house while he was continuing daily to absorb the arsenic or lead which was poisoning him, than to expect better food and housing to cure any worker who is habitually accumulating within himself the chemical poisons of fatigue, generated at every breath. Nothing can cure him and restore the buoyant resistance from which alone health springs, which does not allow the actual *time off* from work, for repair and recuperation.

It is true that the psychologists tell us, and with them

* The Harvey Lectures, 1905–06, p. 179. Philadelphia, Lippincott Co., 1908.

the nerve specialists, that to a certain degree the fatigue threshold may be made to shift; that we may discipline ourselves to endurance so as to tap new levels of energy, "masked until then by the fatigue obstacle usually obeyed."

The most famous of American psychologists, who was also one of the "best practical knowers of the human soul," has written upon this phenomenon of "second wind," in an essay of characteristic insight and felicity which has sometimes been quoted as though in defense of any kind of overexertion:*

"We have to admit," says James, "the wider potential range and the habitually narrow actual use. We live subject to arrest by degrees of fatigue which we have come only from habit to obey. Most of us may learn to push the barrier farther off, and to live in perfect comfort on much higher levels of power. . . .

"Stating the thing broadly, the human individual thus lives usually far within his limits; he possesses powers of various sorts which he habitually fails to use. He energizes below his *maximum,* and he behaves below his *optimum.*"

Why not assume, then, it has been argued, that the workers who are subject to industrial overpressure learn to push *their* fatigue barriers farther off and sustain the intensity of their tasks in proportion to their new-found powers?

But such an argument strangely distorts the doctrine of second wind, which is something far deeper and more "qualitative" than a stress upon mere bodily exertions and activities.

"When I speak of 'energizing' and its rates and levels and sources, I mean therefore our inner as well as our outer work. . . . To relax, to say to ourselves (with the 'new thoughters') 'Peace! be still!' is sometimes a great achievement of inner work."

Far from justifying even remotely the industrial strains

* James, William: The Energies of Men. Memories and Studies, p. 227. New York, Longmans, Green and Co., 1911.

and stresses such as we have been considering, James specifically limits his plea for deeper and more intensive living by the proviso "so long as decent hygienic conditions are preserved."

But our quarrel with the conditions of industrial labor is precisely that they are *not* "decent hygienic conditions." They are not normal media for human living, and they never can be so long as they continue to infract the first mandates of hygiene, the laws of metabolic equilibrium.

There is a practical consideration also for putting first among the forces which undermine health, the length of the workday. The cure for this injury lies at hand. Shortening the workday is something that legislation can effect for women and children today, for men doubtless in the future. But better conditions within the home—better sanitation, better nutrition and hygiene—can never be enforced by outside authority and can come only by slow process of education as people gradually learn to recognize such needs. The community can demand and enforce the requirement that workers be dismissed from factory and store at a given time. It can never *enforce* the requirements of hygiene at home except when their neglect becomes a public danger, through infection and the like. Hence the establishment of a shorter day is an immediate and practicable as well as an indispensable step towards conserving health.

But this practical consideration fades into insignificance beside the fact that the "few extra hours of work" which our casual critic so under-rates, can wholly undo the benefits of a higher standard of living, even were it assured by long hours. Consider, for instance, the vital matter of nutrition. It is well known that digestion is one of the first bodily functions to suffer in exhaustion. Exhaustion, as it drains our nervous energies, deranges the unconscious reflex activities of the nervous system which, as we have seen, regulate the unconscious actions of our organs—heart, stomach, intestines, and the rest. Their normal action is impaired or retarded.

What, then, is the benefit of a more ample diet if the organism is not in a fit condition to digest what is offered it? The habitually exhausted person scarcely profits from the increased food which larger wages afford, if after excessive work he literally cannot digest it. It has been too dearly bought. So, too, the nervous heart troubles and palpitations among working people of which Dr. Lübenau and the others write,—what are they but derangements of the nervous mechanism which regulates our most vital organ? What good to the worker are the higher standards,—better food, clothing, and shelter—so long as over-fatigue continues to limit or destroy his capacity of enjoying them?

Thus fatigue does mischief negatively as well as positively: lowering vitality and breeding disease is its active and positive aspect. Shutting out the exhausted from their rightful heritage, contracting, binding, inhibiting, is its negative. Other faculties suffer as well as the vital bodily functions. For as exhaustion nullifies the benefits of better food and shelter, so, too, it paralyzes the higher activities, all that feeds man's mental and spiritual needs. The higher standard of living includes besides food and drink and clothing, better education, saner amusements, nobler recreation. But as the over-fatigued digestion fails, so over-fatigued hearing is blunted, over-fatigued attention and appreciation flag. Offer what opportunities you will to the exhausted organism, they fall upon literally deafened ears.* Fatigue so closes the avenues of approach within, that education does not educate, amusement does not amuse, nor recreation recreate. Books and learning, pictures, music, play—all these enfranchisements of the spirit lose their power. "Our fires are damped, our drafts are checked." The wings of freedom are clipped, wings that soar above

> "the heavy and the weary weight
> Of all this unintelligible world."

* Archivio Italiano di Otologia, Rinologia e Laringolavia, July, 1907, No. 4. Della Influenza della fatica sull'organo dell'udito. Dr. Luigi Ragani and Dr. Vincenzo Frazola.

To be so crippled is deplorable enough for any members of society. It is the more so for industrial workers because, with industry as it exists, their development as human beings is more and more dependent upon the use of leisure. It is the peculiar sin of monotonous and subdivided labor that it destroys what we inadequately call pleasure in work,—the ever-so-slight satisfaction of man's creative sense, his dimmest feelings of mastery or self-expression in work, often more pain than joy.

The stress upon spontaneity and joy in work in the foregoing extracts from foreign insurance studies cannot have failed to strike the reader. It is the language of Ruskin and Morris on the lips of German insurance physicians. They actually talk as though there were after all a palpable connection between machine routine and deterioration, between health and the love of work. And these are not merely æsthetic considerations by theorists or dreamers. These physicians are not dealing with the stuff that dreams are made of. They are not seeking to evolve new theories or schemes of industry. They are as yet merely individual scientific observers, struck by brute facts which cannot be escaped: the enormous increase of certain forms of disease and suffering among working people year by year.

In time to come, means may again be found for the play of individuality in work, for some freedom of the human agent from the machine. Industrial training tends in this direction by giving the young some perspective, and teaching the relation of circumscribed tasks to wholes of which they are parts. A medical examination of young persons before employment which would start them towards work for which they are physically fit, and the restriction of all workers from tasks for which they are clearly unfit, will also help to emphasize the human element in manufacture and commerce. The wiser scientific management of businesses also offers vistas of betterment.

But in the main, and viewing the whole trend of industry, we cannot conceal from ourselves that its prodigious

processes are deadening to spontaneity, and that they are becoming more so. We can no more check subdivision and monotony than the pace of the machines. But we can seek to imbue the purely economic view of the workers, as units of production, by a broader physiological spirit. Our studies in fatigue have shown that human power is not a static thing, which can be screwed up to the sticking place and remain there. The workers' muscular powers may be raised to what seems like the *n*th degree, and yet they may fail, broken and unstrung, at an age when working capacity should still be at its height.

It is a truism that trade life in America has been shorter than in foreign countries, where the pace is slower. The race is to the swift in a sense never dreamt of before, and in our industries the swift are necessarily the young, even the very young.

The pace has indeed been kept so high in many great trades, partly because the steady flow of immigration keeps bearing to our shores at intervals of time, young laborers of new immigrant races, able to replace those workers who have broken under the strain. So long as immigration streams westward it may be expedient, from a narrow economic point of view, to press all workers to their physical limits, and to dismiss them so soon as efficiency shows signs of failing. What shall we say from the physiological or racial point of view?

We must bear in mind throughout that the essence of this newer view is its insistence on conserving the energies of men. In this the physiologist voices a larger, intrinsic demand of Democracy itself. He cannot consider man's output separate from himself, nor this year's nor next year's efficiency apart from its effects on future health and energy. Ten years' continuance at a maximum pace is in itself no criterion at all for the physiologist. Even one whole generation is too short to measure the ravages of anti-physiological living; and when overwork unfits man or woman for normal parenthood, it is in a deep sense, anti-physiological and anti-

social. It touches not alone the welfare but the very fibre of human society, that congregate "whole," which it should be our passionate concern to recognize, in the stirring words of the Supreme Court, as "no greater than the sum of all its parts," for "when the individual health, safety and welfare are sacrificed or neglected, the state must suffer."

Granting the truth of the Industrial Commission's conclusion ten years ago—that no program for reducing the intensity of exertion can succeed—there remains another horn of the dilemma, the reduction of the work day.

The workers' time and vitality need not be all consumed in their tasks. In leisure other ranges of the spirit are unfolded: "another race hath been, and other palms are won." The limitation of working hours, therefore, which assures leisure, is not a merely negative program. It limits work, indeed, to make good the daily deficits, and to send back the worker physiologically prepared for another day. It frees the worker from toil before exhaustion deprives leisure of its potentialities. It thus fulfils a reasoned purpose. As the physiological function of rest is to repair fatigue, so the function of the shorter day is to afford to working people physiological rest—with all that is implied further by way of leisure.

APPENDICES

EXPLANATORY NOTE

The laws regulating women's hours of labor are here shown in two forms. For complete statement, extracts from the statutes are given in alphabetical order, beginning page 305. In addition the comparative schedules show at a glance the standing of each state with regard to the degree of protection afforded. States are listed according to the number of hours of labor allowed, in a scale increasing from the shortest hours to the longest. The hours allowed in the most important places of employment (manufacturing, mercantile, laundries, etc.) are first separately shown in the schedules, and a summary table is then given (Schedule A, No. 7) showing all the establishments included in each law. (This compilation was made in November, 1912.)

It is difficult in a brief compass to set forth laws with many great and small differences and exceptions. None of the schedules is complete in itself; they must be used together, as shown in the footnotes, to obtain a complete statement. The method here used has been adopted because it most readily reveals the defects and the benefits of each law, and because it has been found less confusing to the reader than the attempt to cover all points in one inclusive schedule.

Only those statutes are included which regulate the hours of labor of all women, irrespective of age.

APPENDIX A

LAWS REGULATING WOMEN'S LABOR

I. COMPARATIVE SCHEDULES

A. HOURS OF LABOR

1. MANUFACTURING ESTABLISHMENTS

(24 states limit the hours of labor)

Hours in One Day	*Hours in One Week*	*State*
8	48	California
"	—	Washington
9	54	Missouri
"	"	Utah
9⅔	58	New Hampshire[a]
10	54	Massachusetts[a]
"	"	Michigan
"	"	New York
"	"	Ohio
10	55	Wisconsin[b]
10	56	Rhode Island[a]
10	58	Connecticut[a]
"	"	Maine[a]
"	"	Minnesota[a]
10	60	Kentucky
"	"	Louisiana
"	"	Maryland[a b]
"	"	Nebraska
"	"	New Jersey
"	"	Oregon
10	—	Illinois
"	—	Virginia
—	60	Tennessee
12	60	Pennsylvania

[a] For overtime, see Schedule B, p. 302.

[b] For night work, see Schedule D, p. 304.

No Legal Limitation of Hours in Manufacturing Establishments

(23 states and the District of Columbia *)

Alabama	Idaho	North Dakota‡
Arkansas	Iowa	Oklahoma‡
Arizona	Kansas	South Carolina‡
Colorado†	Mississippi‡	South Dakota‡
Delaware	Montana	Texas
District of Columbia	Nevada	Vermont
Florida	New Mexico	West Virginia
Georgia‡	North Carolina‡	Wyoming

* Indiana has no limitation of hours in the daytime. For prohibition of night work see Schedule D, p. 304.

† Act of 1903 held unconstitutional. 41 Col. 495.

‡ Statutes so drawn as obviously to be nullified by their own wording. See pp. 307, 311, 313, 314, 316, and 317.

2. MERCANTILE ESTABLISHMENTS
(19 states limit the hours of labor)

Hours in One Day	*Hours in One Week*	*State*
8	48	California
"	—	Washington
9	54	Missouri
"	"	Utah
10	54	Michigan
10	55	Wisconsin[a]
—	58	Connecticut[a] [b]
"	"	Massachusetts [f]
"	"	Minnesota
10	60	Kentucky
"	"	Louisiana[c]
"	"	Maryland[a]
"	"	Nebraska
"	"	New Jersey[d]
"	"	Oregon
10	—	Illinois
"	—	Virginia[e]
12	60	Pennsylvania
"	"	South Carolina

[a] For night work, see Schedule D, p. 304.

[b] Except between December 17th and 25th, provided that seven holidays with pay are given in each year.

[c] Except Saturdays and twenty days before Christmas.

[d] Except six working days next preceding Christmas.

[e] Except Saturdays, or in towns of less than 2,000 inhabitants, or in country districts.

[f] In a workshop for altering or repairing garments, connected with a retail mercantile establishment, not more than 56 hours in any one week.

NO LEGAL LIMITATION OF HOURS IN MERCANTILE ESTABLISHMENTS
(29 states and the District of Columbia)

Alabama	Georgia	Montana	Ohio*
Arizona	Idaho	Nevada	Oklahoma
Arkansas	Indiana	New Hampshire	Rhode Island
Colorado	Iowa	New Mexico	South Dakota
Delaware	Kansas	New York	Tennessee
D. C.	Maine	North Carolina	Texas
Florida	Mississippi	North Dakota	Vermont
West Virginia			Wyoming

* Case involving the inclusion of mercantile establishments in Ohio statute pending before the United States Supreme Court.

3. LAUNDRIES

(23 states limit the hours of labor)

Hours in One Day	*Hours in One Week*	*State*
8	48	Arizona[a]
"	"	California
"	—	Washington
9	54	Missouri
"	"	Utah
9⅓	58	New Hampshire[a]
10	54	Massachusetts[a]
"	"	Michigan
"	"	New York
"	"	Ohio
10	55	Wisconsin[b]
10	56	Rhode Island[a]
10	58	Connecticut[a]
"	"	Maine[a]
"	"	Minnesota[a]
10	60	Kentucky
"	"	Louisiana
"	"	Maryland[a]
"	"	Nebraska
"	"	New Jersey
"	"	Oregon
10	—	Illinois
12	60	Pennsylvania

[a] For overtime, see Schedule B, page 302.
[b] For night work, see Schedule D, page 304.

No Legal Limitation of Hours in Laundries

(25 states and the District of Columbia)

Alabama	Iowa	Oklahoma
Arkansas	Kansas	South Carolina
Colorado	Mississippi	South Dakota
Delaware	Montana	Tennessee
District of Columbia	Nevada	Texas
Florida	New Mexico	Vermont
Georgia	North Carolina	Virginia
Idaho	North Dakota	West Virginia
Indiana		Wyoming

4. THE TELEPHONE AND TELEGRAPH SERVICE

(10 states limit the hours of labor)

Hours in One Day	*Hours in One Week*	*State*
8	48	California
"	—	Washington
9	—	Montana (Except to relieve another employe in case of sickness or other unforeseen cause or causes. Applies only to telephones in cities or towns of 3,000 or more.)
"	54	Utah (Except in cases of emergency, or where life or property is in danger.)
10	54	Ohio
10	55	Wisconsin[a]
10	60	Kentucky
"	"	Louisiana
"	"	Oregon
10	—	Illinois

[a] For night work, see Schedule D, page 304.

No Legal Limitation of Hours in Telephone and Telegraph Establishments

(38 states and the District of Columbia)

Alabama	Maine	North Carolina
Arizona	Maryland	North Dakota
Arkansas	Massachusetts	Oklahoma
Colorado	Michigan	Pennsylvania
Connecticut	Minnesota	Rhode Island
Delaware	Mississippi	South Carolina
District of Columbia	Missouri	South Dakota
Florida	Nebraska	Tennessee
Georgia	Nevada	Texas
Idaho	New Hampshire	Vermont
Indiana	New Jersey	Virginia
Iowa	New Mexico	West Virginia
Kansas	New York	Wyoming

5. RESTAURANTS

(11 states limit the hours of labor)

Hours in One Day	*Hours in One Week*	*State*
8	48	California
"	—	Washington
9	54	Utah
10	54	Ohio
10	55	Wisconsin[a]
10	60	Kentucky
"	"	Nebraska
"	"	New Jersey
"	"	Oregon
10	—	Illinois
—	58	Massachusetts

[a] For night work see Schedule D, page 304.

No Legal Limitation of Hours in Restaurants

(37 states and the District of Columbia)

Alabama
Arizona
Arkansas
Colorado
Connecticut
Delaware
District of Columbia
Florida
Georgia
Idaho
Indiana
Iowa
Kansas
Louisiana
Maine
Maryland
Michigan
Minnesota
Mississippi
Missouri
Montana
Nevada
New Hampshire
New Mexico
New York
North Carolina
North Dakota
Oklahoma
Pennsylvania
Rhode Island
South Carolina
South Dakota
Tennessee
Texas
Vermont
Virginia
West Virginia
Wyoming

6. HOTELS

(7 states limit the hours of labor)

Hours in One Day	*Hours in One Week*	*State*
8	48	California
"	—	Washington
9	54	Utah
10	60	Kentucky
"	"	Nebraska
"	"	Oregon
10	—	Illinois

No Legal Limitation of Hours in Hotels

(41 states and the District of Columbia)

Alabama
Arizona
Arkansas
Colorado
Connecticut
Delaware
District of Columbia
Florida
Georgia
Idaho
Indiana
Iowa
Kansas
Louisiana
Maine
Maryland
Massachusetts
Michigan
Minnesota
Mississippi
Missouri
Montana
Nevada
New Hampshire
New Jersey
New Mexico
New York
North Carolina
North Dakota
Ohio
Oklahoma
Pennsylvania
Rhode Island
South Carolina
South Dakota
Tennessee
Texas
Vermont
Virginia
West Virginia
Wisconsin
Wyoming

7. ESTABLISHMENTS INCLUDED
(27 states limit the hours of labor)

Year Enacted	*Hours in One Day*	*Hours in One Week*	*State and Establishments Included*
1909	8	48	Arizona[a]—Laundry.
1911	"	"	California[b]—Manufacturing, mechanical or mercantile, laundry, hotel, restaurant, telegraph or telephone office, express or transportation company.
1911	8	—	Washington[b]—Mechanical or mercantile, laundry, hotel or restaurant, telegraph or telephone service.
1911	9	54	Missouri — Manufacturing, mechanical and mercantile, laundry, workshop.
1909	"	—	Montana—Telephone switchboards in cities or towns having more than 3,000 inhabitants.
1911	"	54	Utah[b]—Manufacturing, mechanical, or mercantile, laundry, hotel, or restaurant, telegraph or telephone, hospital or office, express or transportation company.
1907	9⅔	58	New Hampshire[a]—Manufacturing or mechanical, laundry.
1912	10	54	Massachusetts[a] — Manufacturing or mechanical, laundry.
1911	"	"	Michigan[b]—Factory, mill, warehouse, workshop, clothing, dressmaking or millinery, any place where the manufacture of any kind of goods is carried on, or where any goods are prepared for manufacturing, laundry, store, shop, mercantile.

[a] For overtime, see Schedule B, page 302.
[b] For exemptions, see Schedule C, page 303.

7. ESTABLISHMENTS INCLUDED—(Continued)

Year Enacted	*Hours in One Day*	*Hours in One Week*	*State and Establishments Included*
1912	10	54	New York[b]—Factory, laundry.
1911	"	"	Ohio[b]—Factory, workshop, restaurant, telephone or telegraph office, millinery or dressmaking, distribution or transmission of messages, laundry.
1911	10	55	Wisconsin[c] — Manufacturing, mechanical or mercantile, laundry, restaurant, confectionery store, telegraph or telephone office or exchange, express or transportation company. For night work between 8 p. m. and 6 a. m.—except one night in week—not more than 8 hours in 24, and 48 in one week.
1909	10	56	Rhode Island[a] — Manufacturing or mechanical, laundry.
1911	10	58	Connecticut[a] — Manufacturing or mechanical, laundry
1911	"	"	Maine[a b]—Manufacturing or mechanical, laundry.
1909	"	"	Minnesota[a] — Manufacturing or mechanical, laundry.
1912	10	60	Kentucky—Laundry, bakery, factory, workshop, store, or mercantile, manufacturing or mechanical, hotel, restaurant, telephone or telegraph office.

[a] For overtime, see Schedule B, page 302.
[b] For exemptions, see Schedule C, page 303.
[c] For night work, see Schedule D, page 304.

7. ESTABLISHMENTS INCLUDED—(Continued)

Year Enacted	*Hours in One Day*	*Hours in One Week*	*State and Establishments Included*
1908	10	60	Louisiana[b]—Mill, factory, mine, packing house, manufacturing, workshop, laundry, millinery or dressmaking, store or mercantile establishment, in which more than five persons are employed, theater, concert hall, in or about any place of amusement where intoxicating liquors are made or sold, bowling alley, bootblacking establishment, freight or passenger elevator, transmission or distribution of messages, telegraph or telephone, or any other messages or merchandise, or any occupation not enumerated which may be deemed unhealthful or dangerous.
1912	"	"	Maryland[abc]— Manufacturing, mechanical, mercantile, printing, baking or laundering.
1911	"	"	Nebraska — Manufacturing, mechanical, mercantile, hotel, restaurant, laundry.
1912	"	"	New Jersey[b]— Manufacturing or mercantile, bakery, laundry, restaurant.
1909	"	"	Oregon—Manufacturing, mechanical, mercantile, laundry, hotel, restaurant, telegraph or telephone office, express or transportation company.

[a] For overtime, see Schedule B, page 302.
[b] For exemptions, see Schedule C, page 303.
[c] For night work, see Schedule D, page 304.

7. ESTABLISHMENTS INCLUDED—(Concluded)

Year Enacted	*Hours in One Day*	*Hours in One Week*	*State and Establishments Included*
1911	10	—	Illinois—Mechanical or mercantile, factory, laundry, hotel, restaurant, telegraph or telephone office, any place of amusement, any express or transportation or public utility business, any common carrier, or any public institution.
1912	"	—	Virginia[b]—Factory, workshop, mercantile, or manufacturing.
1911	—	58	Connecticut[b] [c]—Mercantile.
1909	—	"	Massachusetts — Mercantile, restaurant.
1909	—	"	Minnesota — Mercantile.
1907	—	60	Tennessee — Manufacturing.
1909	12	60	Pennsylvania — Establishments other than where domestic, coal-mining or farm labor is employed, laundry.
1911	"	"	South Carolina[c] — Mercantile.

[a] For overtime, see Schedule B, page 302.
[b] For exemptions, see Schedule C, page 303.
[c] For night work, see Schedule D, page 304.

8. NO LEGAL LIMITATION OF HOURS WHATSOEVER

(20 states* and the District of Columbia)

Alabama	Florida	Mississippi‡	Oklahoma‡
Arkansas	Georgia‡	Nevada	South Dakota‡
Colorado†	Idaho	New Mexico	Texas
Delaware	Iowa	North Carolina‡	Vermont
D. C.	Kansas	North Dakota‡	West Virginia
		Wyoming	

* Indiana has no limitation of hours in the day time. For prohibition of night work see Schedule D, page 304.

† Act of 1903 held unconstitutional. 41 Col. 495.

‡ Statutes so drawn as obviously to be nullified by their own wording. See pp. 307, 311, 313, 314, and 317.

B. OVERTIME ALLOWED

1. MANUFACTURING AND MECHANICAL ESTABLISHMENTS

Five states allow overtime for the three following reasons:

(a) In order to obtain one short day in the week.

(b) In order to make repairs to prevent interruption of ordinary running of machinery.

(c) To make up time lost on some previous day of same week in consequence of stopping machinery.

Overtime Allowed	Restriction	*State*
Hours in One Day	*Total Hours in One Week Not to Exceed*	
Unrestricted	48	Arizona (Laundries only)
	56	Rhode Island
	58	Connecticut[a] Maine[b] New Hampshire

[a] Sixty hours a week allowed, if 55 hours in June, July and August.

[b] Females may contract to labor over 10 hours in a day, not to exceed 6 hours in one week or 60 hours in one year.

One state allows overtime for the two following reasons:

(d) In order to obtain one short day in the week.

(e) To make up for stopping machinery over 30 minutes on previous day of same week.[a]

Overtime Allowed	Restriction	*In Manufacturing or Mechanical Establishments*
Hours in One Day	*Total Hours in One Week Not to Exceed*	
Unrestricted	58	Minnesota

[a] Massachusetts allows overtime for this reason (e) after authorization by inspecting officials.

(f) To meet exceptional seasonal demands.

Overtime Allowed		Restriction	State
In One Day	*In One Week*		
12	—	Not more than 6 weeks in any year, if entire working force is employed on full time for entire year and if during 4 months immediately preceding overtime, working day of less than 9 hours has been established.	Maryland (applying only to Allegany County)
10	58	Provided that total hours shall not exceed an average of 54 hours in a week for whole year, excluding Sundays and holidays.	Massachusetts

C. EXEMPTIONS: HOURS UNRESTRICTED

1. MERCANTILE ESTABLISHMENTS

(a) Christmas exemption

Dec. 17–25.....Connecticut (provided 7 holidays with pay are given in each year)
Dec. 5–25.....Louisiana
Dec. 19–25.....New Jersey

(b) Saturday exemption

Louisiana Virginia

2. CANNING ESTABLISHMENTS

California
Maine
Maryland
Michigan
New Jersey
New York (between June 15 and Oct. 15)
Ohio
Utah
Virginia (between July 1 and Nov. 1)
Washington

D. NIGHT WORK

1. NIGHT WORK PROHIBITED (4 States)

Work Prohibited Between		*State and Kinds of Establishments*
P. M.	*A. M.*	
6	6	Massachusetts—in textile manufacture
10	6	Indiana—in manufacture.
"	"	Massachusetts—in manufacture other than textile.
"	"	Nebraska—in manufacturing, mechanical, or mercantile establishment, hotel or restaurant.
After 10		South Carolina—in stores.

2. NIGHT WORK PERMITTED BUT LIMITED (3 States)

Work Limited Between		*State and Limitation*
P. M.	*A. M.*	
8	6	Wisconsin—Not more than 8 hours in 24 hours, and 48 hours in one week. But if work is carried on only one night in the week, restriction of hours same as for day work.
10	6	Maryland—Not more than 8 hours in 24 hours.
After 10	—	Connecticut—If work continues after 10 p. m. not more than to make a total of 10 hours in 24 hours in mercantile establishments.

3. NIGHT WORK UNLIMITED OR SAME AS DAY LIMITATION (42 States and District of Columbia)

Alabama	Iowa	New Hampshire	South Carolina
Arizona	Kansas	New Mexico	(except in stores)
Arkansas	Kentucky	New Jersey	South Dakota
California	Louisiana	New York	Tennessee
Colorado	Maine	North Carolina	Texas
Delaware	Michigan	North Dakota	Utah
D. C.	Minnesota	Ohio	Vermont
Florida	Mississippi	Oklahoma	Virginia
Georgia	Missouri	Oregon	Washington
Idaho	Montana	Pennsylvania	West Virginia
Illinois	Nevada	Rhode Island	Wyoming

II. EXTRACTS FROM STATUTES

Arizona

Enacted in 1909 (chap. 100, sec. 1).

"The period of employment of working women and other persons who shall be employed in working in the laundry department in any laundry establishment, shall be eight hours in any one day, . . . and in no case shall the hours of labor exceed forty-eight hours in a week."

Overtime allowed on any day, provided that the hours of labor shall not exceed forty-eight in one week.

1. In order to obtain one shorter day in the week.
2. To make repairs to prevent interruption of ordinary running of the machinery.
3. To make up time lost on some previous day of same week in consequence of stopping machinery.

California

Enacted in 1911 (chap. 258, sec. 1).

"No female shall be employed in any manufacturing, mechanical or mercantile establishment, laundry, hotel, or restaurant, or telegraph or telephone establishment or office, or by any express or transportation company in this state more than eight hours during any one day or more than forty-eight hours in one week. The hours of work may be so arranged as to permit the employment of females at any time so that they shall not work more than eight hours during the twenty-four hours of one day, or forty-eight hours during any one week."

(Held constitutional, Matter of Miller, 124 Pacific Rep. 427.)

Exemption allowed for the harvesting, curing, canning or drying of any variety of perishable fruit or vegetable.

Connecticut

First enacted in 1887 (chap. 62, sec. 1), now embodied in Acts of 1909 (chap. 220), amended by Acts of 1911 (chap. 278).

". . . No woman shall be employed in laboring in any manufacturing or mechanical establishment more than ten hours in any day . . . but in no case shall the hours of labor exceed fifty-eight in a calendar week: *Provided*, That in case any employer in such establishment shall, on or before the first day of January of any year, give notice to his employees, by notices posted as hereinbefore provided, that the hours of labor of minors under sixteen years of age and of women employed by him, as aforesaid, shall not exceed fifty-five in any week during the months of June, July, and August of the ensuing calendar year, then said employer may employ such minors and women not to exceed sixty hours in any week during said year, except during said months of June, July, and August."

Overtime allowed on any day, provided that hours of labor shall not exceed fifty-eight in one week.

1. In order to obtain one shorter day in the week.
2. To make repairs to prevent interruption of ordinary running of the machinery.
3. To make up time lost on some previous day of same week in consequence of stopping machinery.

(Sec. 2.) ". . . No woman shall be employed in laboring in any mercantile establishment, other than manufacturing or mechanical, more than fifty-eight hours in any calendar week." (Same proviso as above allowing sixty hours in any week, if notices are posted by January first that hours shall not exceed fifty-five in any week in June, July and August.)

Exemption allowed between December 17th to 25th if not less than seven holidays with pay be given during the year.

(Sec. 3.) ". . . No woman shall in any event be employed in laboring in any such establishment as is described in section two hereof (mercantile, other than manufacturing or mechanical) after ten o'clock in the evening of any day, unless the employer in such establishment shall, on such day, employ two or more shifts or sets of such employees, in which event no one such shift or set of employees shall be employed during more than ten hours of such day."

Georgia*

First enacted in 1889 (Code of State of Georgia, Vol. II. p. 292, sec. 2615), amended in 1911 (No. 279).

"The hours of labor required of all persons employed in all cotton or woolen manufacturing establishments in this State, except engineers, firemen, watchmen, mechanics, teamsters, yard employees, clerical force, and all help that may be needed to clean up and make necessary repairs or changes in or of machinery, shall not exceed ten hours per day, or the same may be regulated by employers, so that the number of hours shall not in the aggregate exceed sixty hours per week."

Overtime allowed, to make up lost time, not to exceed ten days, caused by accidents or other unavoidable circumstances.

Illinois

First enacted in 1909 (p. 212), amended by Acts of 1911 (p. 328).

". . . No female shall be employed in any mechanical or mercantile establishment, or factory, or laundry, or hotel, or restaurant, or telegraph or telephone establishment or office thereof, or in any place of amusement, or by any person, firm or corporation engaged in any express or transportation or public utility business, or by any common carrier, or in any public institution, incorporated or unincorporated in this State, more than ten hours during any one day. The hours of work may be so arranged as to permit the employment of females at any time so that they shall not work more than ten hours during the twenty-four hours of any day."

(Act of 1909 held constitutional, Ritchie & Co. *v.* Wayman, 244 Ill. 509. Act of 1911 held constitutional, People *v.* Eldering, 98 Northeastern Rep. 982.)

Indiana

Enacted in 1894, embodied in Anno. Stat, 1908, S. 8021, etc.

"No person or corporation, or officer or agent thereof, shall employ any woman . . . in any capacity for the purpose of manu-

* This statute is obviously nullified by its own wording and is therefore in the preceding schedules listed with states having no legislation.

facturing, between the hours of 10 o'clock at night and 6 o'clock in the morning."

Kentucky

First enacted in 1912 (chap. 77).

"No female of whatever age shall be employed, or suffered, or permitted to work in any laundry, bakery, factory, work-shop, store, or mercantile, manufacturing or mechanical establishment, or hotel, restaurant, telephone exchange or telegraph office, more than sixty hours in any one week, nor more than ten hours in any one day."

Louisiana

First enacted in 1886 (Act No. 43), amended by Acts of 1908 (No. 301, sec. 4).

". . . No woman shall be employed in any of the places and industries enumerated in section 1 of this act (mill, factory, mine, packing-house, manufacturing establishment, workshop, laundry, millinery or dressmaking, store or mercantile establishment in which more than five persons are employed, or in any theater, concert hall or in or about any place of amusement where intoxicating liquors are made or sold, or in any bowling-alley, boot-blacking establishment, freight or passenger elevator, or in the transmission or distribution of messages, either telegraph or telephone, or any other messages, or merchandise, or in any other occupation not herein enumerated which may be deemed unhealthful or dangerous. Agriculture and domestic industries excepted) for a longer period than ten hours per day or sixty hours per week."

(Held constitutional, State *v.* Grunewald, Crim. Dist. Court, Judge Joshua G. Baker, decided Apr. 20, 1911.)

Exemption allowed for stores and mercantile establishments on Saturday nights or twenty days before Christmas.

Maine

First enacted in 1887 (chap. 139, sec. 1), re-enacted in Revised Statutes, 1903, chap. 40, sec. 48, amended by Acts of 1909 (chap. 70) and Acts of 1911 (chap. 55).

". . . No woman shall be employed in laboring in any manufacturing or mechanical establishment in the State, more than ten

hours in any one day; . . . and in no case shall the hours of labor exceed 58 in a week; . . . *Provided, however,* that any female of eighteen years of age or over, may lawfully contract for such labor for any number of hours in excess of ten hours a day, not exceeding six hours in any one week, or sixty hours in any one year, receiving additional compensation therefor."

Overtime allowed on any day, provided hours of labor do not exceed fifty-eight in any week.

1. In order to obtain a shorter day in the week.
2. To make repairs to prevent interruption of the ordinary running of the machinery.
3. To make up time lost on previous day of same week in consequence of stopping machinery.

Exemption allowed for any manufacturing establishment or business, the materials and products of which are perishable and require immediate labor thereon to prevent decay or damage.

Maryland

First enacted in 1887 (chap. 139, sec. 1), re-enacted in Code of Pub. Gen. Laws, 1903, art. 100, sec. 1, amended by Laws of 1912 (chap. 79).

"No female shall be employed or permitted to work in any manufacturing, mechanical, mercantile, printing, baking or laundering establishment more than ten hours in any one day, nor more than sixty hours in any one week, nor more than eight hours in any one day if any part of her work is done before six o'clock in the morning or after ten o'clock in the evening of the said day. . . . Provided that in Allegany County any person or persons subject to this Act in whose establishment the average working day for the entire year does not exceed nine hours and in which the entire working force is employed on full time for the entire year and who, for a period not less than four months has established for such employees a working day of less than nine hours, may, for a period immediately thereafter, not exceeding six weeks, employ their employees for not more than twelve hours in any one calendar day, to meet the exigencies of exceptional seasonable demands upon the trade or industry in which they are employed."

Exemption allowed for canning, or preparation for canning, perishable fruits and vegetables.

Massachusetts

First enacted in 1874 (chap. 221), now embodied in Acts of 1909, chap. 514, sec. 48, as amended by Acts of 1911 (chaps. 484 and 313), and by Acts of 1912 (chap. 477).

". . . No woman shall be employed in laboring in a manufacturing or mechanical establishment more than ten hours in any one day . . . and in no case shall the hours of labor exceed fifty-four in a week, except that in any such establishment where the employment is by seasons, the number of such hours in any week may exceed fifty-four, but not fifty-eight. *Provided*, That the total number of such hours in any year shall not exceed an average of 54 hours a week for the whole year, excluding Sundays and holidays." "In any workshop for altering or repairing garments, connected with a (retail) mercantile establishment . . . , women shall not be employed more than 56 hours in any one week."

(Held constitutional, Comm. *v.* Hamilton Mfg. Co., 120 Mass. 383.)

Overtime allowed on any day, provided that the hours of labor do not exceed 54 in one week.

1. To make up for stopping machinery in excess of 30 minutes.

(Sec. 47.) "No woman shall be employed in laboring in a mercantile establishment more than fifty-eight hours in a week."

(Sec. 51.) "No person, and no agent or officer of a person or corporation, shall employ a woman or minor in any capacity for the purpose of manufacturing between ten o'clock at night and six o'clock in the morning. No person, and no agent or officer of a person or corporation engaged in the manufacture of textile goods, shall employ a woman or a minor before six o'clock in the morning or after six o'clock in the evening."

Michigan

Enacted in 1909 (Act No. 285, sec. 9), re-enacted 1911 (Act No. 220, sec. 9).

". . . No female shall be employed in any factory, mill, warehouse, workshop, clothing, dressmaking, or millinery establish-

ment, or any place where the manufacture of any kind of goods is carried on, or where any goods are prepared for manufacturing, or in any laundry, store, shop, or any other mercantile establishment, for a period longer than an average of nine hours in a day or fifty-four hours in any week, nor more than ten hours in any one day."

(Held constitutional, Withey *v.* Bloem, 163 Mich. 419.)

Exemption allowed for preserving perishable goods in fruit and vegetable canning establishments.

Minnesota

Enacted in 1909 (chap. 499, sec. 2).

"No female shall be employed in laboring in a manufacturing or mechanical establishment more than ten hours in any one day, . . . and in no case shall the hours of labor exceed fifty-eight in a week."

Overtime allowed on any day, provided that the hours of labor do not exceed fifty-eight in one week.

1. In order to obtain one shorter day in the week.
2. To make up for stopping machinery in excess of thirty minutes.

(Sec. 1.) "No female shall be employed in laboring in a mercantile establishment more than fifty-eight hours in a week."

Mississippi*

Enacted in 1912 (chap. 157).

It shall be unlawful for any person, firm or corporation engaged in manufacturing or repairing to work their employes more than ten hours per day, except in cases of emergency, or where public necessity requires in such departments.

Missouri

First enacted in 1909 (chap. 67, sec. 7815 of the Rev. Stat.), re-enacted by Acts of 1911 (p. 311, sec. 1).

No female shall be employed in any manufacturing or mechanical and mercantile establishment, laundry or workshop, in this State, more than nine hours during any one day, nor more than fifty-four hours during any one week.

*This statute is obviously nullified by its own wording. It is therefore in the preceding schedules listed with states having no legislation.

Montana

Enacted in 1909 (chap. 75, sec. 1).

On all lines of public telephones, operated in whole or in part within this State, it shall hereafter be unlawful for any owner, lessee, company, or corporation to hire or employ any operator or operators, other person or persons, to run or operate a telephone board or boards for more than nine (9) hours, in twenty-four hours in cities or towns having a population of 3,000 inhabitants or over. *Provided, however,* That the provisions of this act shall not apply to any person or persons, operator or operators, operating any telephone board or boards more than nine (9) hours in each twenty-four for the purpose of relieving another employee in case of sickness or other unforeseen cause or causes.

Nebraska

First enacted in 1899 (chap. 107), now embodied in Statutes 1911, sec. 6940.

". . . No female shall be employed in any manufacturing, mechanical or mercantile establishment, hotel or restaurant in this State, more than sixty hours during any one week, and that ten hours shall constitute a day's labor. The hours of each day may be so arranged as to permit the employment of such female at any time from six o'clock a. m. to ten o'clock p. m.; but in no case shall such employment exceed ten hours in any one day.

(Held constitutional in Wenham *v.* State, 65 Neb. 394.)

New Hampshire

First enacted in 1887 (chap. 25, sec. 1), re-enacted by Stat. 1907 (chap. 94).

"No woman . . . shall be employed in a manufacturing or mechanical establishment for more than nine hours and forty minutes in one day . . . In no case shall the hours of labor exceed fifty-eight in one week."

Overtime allowed on any day, provided that the hours of labor do not exceed fifty-eight in one week.

1. In order to obtain one shorter day in the week.
2. To make repairs to prevent interruption of the ordinary running of machinery.

3. To make up time lost on some day in the same week in consequence of stopping machinery.

New Jersey

Enacted in 1912 (chap. 216, sec. 1).

"No female shall be employed, allowed or permitted to work in any manufacturing or mercantile establishment, in any bakery, laundry or restaurant more than ten hours in any one day, or more than six days, or sixty hours in any one week."

Exemption allowed for mercantile establishments for six working days next preceding Christmas, and for canneries engaged in packing a perishable product such as fruits or vegetables.

New York

First enacted in 1899 (chap. 192, sec. 77), now embodied in Con. Laws 1909, chap. 31, as amended to Oct. 1, 1912. Art. VI. secs. 77, 78, 89.

". . . No woman shall be employed or permitted to work in any factory in this State . . . more than six days or fifty-four hours in any one week; nor for more than nine hours in any one day except as hereinafter provided.

"A female sixteen years of age or upwards . . . may be employed in a factory more than nine hours a day: (a) regularly in not to exceed five days a week, in order to make a short day or a holiday on one of the six working days of the week; (b) irregularly in not to exceed three days a week; provided that no such person shall be required or permitted to work more than ten hours in any one day or more than fifty-four hours in any one week. . . ."

Exemption allowed for canning or preserving perishable products in fruit and canning establishments between June 15th and October 15th.

North Carolina*

First enacted in 1907 (chap. 463), amended in 1911 (chap. 85).

* This statute is obviously nullified by its own wording. It is therefore in the preceding schedules listed with states having no legislation.

"Not exceeding sixty hours shall constitute a week's work in all factories and manufacturing establishments of this State. . . . Provided, that this section shall not apply to engineers, firemen, machinists, superintendents, overseers, section and yard hands, office men, watchmen or repairers of breakdowns."

North Dakota*

First enacted in 1877 (Penal Code, sec. 739), now embodied in Revised Code, 1905, sec. 9440.

"Every owner, stockholder, overseer, employer, clerk or foreman of any manufactory, workshop, or other place used for mechanical or manufacturing purposes, who, having control, shall compel any woman . . . to labor in any day exceeding ten hours, shall be deemed guilty of a misdemeanor."

Ohio

First enacted in 1911. Gen. Code. sec. 1008.

"Females over eighteen years of age shall not be employed or permitted or suffered to work in or in connection with any factory, workshop, telephone or telegraph office, millinery or dressmaking establishment, restaurant or in the distributing or transmission of messages more than ten hours in any one day, or more than fifty-four hours in any one week."

(Held constitutional, exparte Hawley, 98 Northeastern Rep. 1126.)

Exemption for canneries or establishments engaged in preparing for use perishable goods.

Oklahoma*

First enacted in 1890 (Stat. 1890, chap. 25, article 58, sec. 10), now embodied in Revised Statutes, 1903, chap. 25, article 58, sec. 729.

"Every owner, stockholder, overseer, employer, clerk, or

* This statute is nullified by its own wording, since the misdemeanor consists in *compelling* any woman to labor more than 10 hours. It is therefore in the preceding schedules listed with states having no legislation.

foreman of any manufactory, workshop, or other place used for mechanical or manufacturing purposes, who, having control, shall compel any woman . . . to labor in any day exceeding ten hours, shall be deemed guilty of a misdemeanor, and upon conviction shall be punished by fine not exceeding one hundred and not less than ten dollars."

Oregon

Enacted in 1903, amended by acts of 1909, chap. 138.

"No female shall be employed in any manufacturing, mechanical or mercantile establishment, laundry, hotel or restaurant, or telegraph or telephone establishment or office, or by any express or transportation company in this State more than ten hours during any one day or more than sixty hours in one week. The hours of work may be so arranged as to permit the employment of females at any time so that they shall not work more than ten hours during the twenty-four of one day, or sixty hours during any one week."

(Held constitutional, Muller *v.* Oregon, 208 U. S. 412.)

Pennsylvania

First enacted in 1897 (No. 26), and re-enacted in Laws of 1905 (No. 226), amended 1909 (No. 182).

". . . The term 'establishment' where used for the purpose of this act, shall mean any place within this Commonwealth other than where domestic, coal mining, or farm labor is employed; where men, women, or children are engaged, and paid a salary or wages, by any person, firm or corporation, and where such men, women, or children are employees, in the general acceptance of the term.

". . . No female shall be employed in any establishment for a longer period than sixty hours in any one week, nor for a longer period than twelve hours in any one day."

(Held constitutional in Comm. *v.* Beatty, 15 Pa. Superior Ct. 5.)

Rhode Island

First enacted in 1885 (chap. 519, sec. 1) now embodied in Laws of 1909 (chap. 384).

". . . No woman shall be employed in laboring in any manufacturing or mechanical establishment more than fifty-six hours in

any one week; and in no case shall the hours of labor exceed ten hours in any one day."

Overtime allowed on any day, provided that the hours of labor shall not exceed fifty-six in one week.

1. In order to obtain one shorter day in the week.
2. To make repairs to prevent interruption of the ordinary running of machinery.
3. To make up time lost on some previous day of the same week in consequence of stopping machinery.

South Carolina

First enacted in 1907 (No. 233), amended in 1909 (Act No. 121, sec. 1).*

" . . . Ten hours a day or sixty hours a week, provided, however, that the hours of a single day shall not exceed eleven hours, except for the purpose of making up lost time as hereinafter provided, shall constitute the hours for working for all operatives and employees in cotton and woolen manufacturing establishments engaged in the manufacture of yarns, cloth, hosiery, and other products for merchandise, except mechanics, engineers, firemen, watchmen, teamsters, yard employees, and clerical force. All contracts for longer hours of work other than herein provided in said manufacturing establishments shall be, and the same are hereby, declared null and void; . . . *Provided*, That nothing herein contained shall be construed as forbidding or preventing any such manufacturing company from making up lost time to the extent of sixty hours per annum, where such lost time has been caused by accident or other unavoidable cause."

Enacted in 1911 (No. 83, sec. 1).

". . . The hours of labor of women employed in mercantile

* This statute is obviously nullified by its own wording. It is therefore in the preceding schedules listed with states having no legislation.

"It has been utterly impossible to bring about any degree of enforcement of the general law relating to hours of labor in textile plants, for the reason that the law, itself, is well-nigh impossible of interpretation, and is so constructed as to make it absolutely impossible to ascertain whether there has been a violation of the intent and purposes of the law or not." Third Annual Report of the South Carolina Commissioner of Agriculture, Commerce and Industries. Labor Division, 1911, p. 4.

establishments in this State shall be limited to 60 hours per week, not to exceed 12 hours in any one day, and . . . such female employees shall not be required to work later than the hour of ten o'clock p. m."

South Dakota*

First enacted in 1877 (Penal Code, sec. 739), now embodied in Revised Code, 1903 (Penal Code, sec. 764).

"Every owner, stockholder, overseer, employer, clerk or foreman, of any manufactory, workshop, or other place used for mechanical or manufacturing purposes, who, having control, shall compel any woman . . . to labor in any day exceeding ten hours, shall be deemed guilty of a misdemeanor."

Tennessee

Enacted in 1907 (chap. 308, sec. 3).

"It shall be unlawful for any person, firm, or corporation to employ in any manufacturing establishment in this State any female . . more than sixty (60) hours in any one week."

Utah

Enacted in 1911 (chap. 133).

"No female shall be employed in any manufacturing, mechanical, or mercantile establishment, laundry, hotel, or restaurant, or telegraph or telephone establishment, hospital or office, or by any express or transportation company in this State, more than nine hours during any one day, or more than fifty-four hours in any one week, except in cases of emergency in hospitals and in cases of emergency or where life or property is in imminent danger."

Exemption allowed for materials liable to spoil by the enforcement of this Act.

Virginia

First enacted in 1890 (chap. 193, sec. 1), now re-enacted and amended by Acts of 1912, chap. 248, sec. 2.

* This statute is obviously nullified by its own wording since the misdemeanor consists in *compelling* any woman to labor more than ten hours. It is therefore in the preceding schedules listed with states having no legislation.

No female . . . shall work as an operative in any factory, workshop, mercantile or in any manufacturing establishment in this State more than ten hours in any one day of twenty-four hours. All contracts made or to be made for the employment of any female . . . as an operative in any factory, workshop, mercantile, or in any manufacturing establishment to work more than ten hours in any one day of twenty-four hours, are and shall be void.

Exemptions allowed for

1. Factories engaged exclusively in packing fruits or vegetables between July 1st and Nov. 1st.
2. Mercantile establishments on Saturdays, or in towns of less than 2,000 inhabitants, or in country districts.
3. Females employed full time as book-keepers, stenographers, cashiers or office-assistants.

Washington

First enacted in 1901 (Stat. 1901, chap. 68, sec. 1).

(Act of 1901 held constitutional in State *v.* Buchanan, 29 Wash. 603.)

Amended in 1911 (chap. 37).

"No female shall be employed in any mechanical or mercantile establishment, laundry, hotel or restaurant in this State more than eight hours during any day. The hours of work may be so arranged as to permit the employment of females at any time so that they shall not work more than eight hours during the twenty-four. . . . If it shall be adjudicated that the foregoing proviso and exception shall be unconstitutional and invalid for any reason, an adjudication of invalidity of said proviso or of any part of this act shall not affect the validity of the act as a whole or any other part thereof."

(Act of 1911 held constitutional, State *v.* Somerville, 122 Pacif. Rep. 324.)

Exemption allowed for harvesting, packing, curing, canning or drying any variety of perishable fruit or vegetable, and canning fish or shell-fish.

Wisconsin

First enacted in 1867 (chap. 83, sec. 1), embodied in Stat. of 1898 (sec. 1728), amended in 1911 (chap. 548).

"No female shall be employed or be permitted to work in any manufacturing, mechanical or mercantile establishment, laundry or restaurant, or confectionery store, or telegraph or telephone office or exchange, or by any express or transportation company, in this State, more than ten hours during any one day, or more than fifty-five hours in any one week. The hours may be so arranged as to permit the employment of females at any time, but they shall not work more than ten hours during the twenty-four hours of any one day, nor more than fifty-five hours during one week. If, however, any part of a female's daily employment is performed between the hours of eight o'clock p. m. and six o'clock a. m. of the following day, all the employment shall be considered night work, and no such female so employed at night work shall be employed or permitted to work thereat more than eight hours in any twenty-four hours, nor more than forty-eight hours during one week. If any such female is employed not more than one night in the week (after eight o'clock as herein provided), then such female may be permitted to work fifty-five hours in any such week."

APPENDIX B

OPINION OF THE SUPREME COURT OF THE UNITED STATES

In the Case of Muller *v.* State of Oregon

Delivered by Mr. Justice Brewer, February 24, 1908

On February 19, 1903, the legislature of the State of Oregon passed an act (Session Laws, 1903, p. 148) the first section of which is in these words:

"Sec. 1. That no female (shall) be employed in any mechanical establishment, or factory, or laundry in this State more than ten hours during any one day. The hours of work may be so arranged as to permit the employment of females at any time so that they shall not work more than ten hours during the twenty-four hours of any one day."

Section 3 made a violation of the provisions of the prior sections a misdemeanor, subject to a fine of not less than $10 nor more than $25. On September 18, 1905, an information was filed in the Circuit Court of the State for the county of Multnomah, charging that the defendant "on the 4th day of September, A. D. 1905, in the county of Multnomah and State of Oregon, then and there being the owner of a laundry, known as the Grand Laundry, in the city of Portland, and the employer of females therein, did then and there unlawfully permit and suffer one Joe Haselbock, he, the said Joe Haselbock, then and there being an overseer, superintendent and agent of said Curt Muller, in the said Grand Laundry, to require a female, to wit, one Mrs. E. Gotcher, to work more than ten hours in said Laundry on said 4th day of September, A. D. 1905, contrary to the statutes in such cases made and provided, and against the peace and dignity of the State of Oregon."

A trial resulted in a verdict against the defendant, who was sentenced to pay a fine of $10. The Supreme Court of the State affirmed the conviction (48 Ore. 252), whereupon the case was brought here on writ of error.

The single question is the constitutionality of the statute under which the defendant was convicted so far as it affects the work of a female in a laundry. That it does not conflict with any provisions of the State constitution is settled by the decision of the Supreme Court of the State. The contentions of the defendant, now plaintiff in error, are thus stated in his brief:

"(1) Because the statute attempts to prevent persons, *sui juris*, from making their own contracts, and thus violates the provisions of the Fourteenth Amendment, as follows:

"'No State shall make or enforce any law which shall abridge the privileges or immunities of citizens of the United States; nor shall any State deprive any person of life, liberty, or property, without due process of law; nor deny to any person within its jurisdiction the equal protection of the laws.'

"(2) Because the statute does not apply equally to all persons similarly situated, and is class legislation.

"(3) The statute is not a valid exercise of the police power. The kinds of work prescribed are not unlawful, nor are they declared to be immoral or dangerous to the public health; nor can such a law be sustained on the ground that it is designed to protect women on account of their sex. There is no necessary or reasonable connection between the limitation prescribed by the act and the public health, safety, or welfare."

It is the law of Oregon that women, whether married or single, have equal contractual and personal rights with men. As said by Chief Justice Wolverton, in *First National Bank* v. *Leonard*, 36 Ore. 390, 396, after a review of the various statutes of the State upon the subject:

"We may therefore say with perfect confidence that, with these three sections upon the statute book, the wife can deal, not only with her separate property, acquired from whatever source, in the same manner as her husband can with property belonging to him, but that she may make contracts and incur liabilities, and the same may be enforced against her, the same as if she were a *feme sole*. There is now no residuum of civil disability resting upon her which is not recognized as existing against the husband. The current runs steadily and strongly in the direction of the emancipation of the wife, and the policy, as disclosed by all recent legislation upon the subject in this State, is to place her upon

the same footing as if she were a *feme sole*, not only with respect to her separate property, but as it affects her right to make binding contracts; and the most natural corollary to the situation is that the remedies for the enforcement of liabilities incurred are made co-extensive and co-equal with such enlarged conditions."

It thus appears that, putting to one side the elective franchise, in the matter of personal and contractual rights they stand on the same plane as the other sex. Their rights in these respects can no more be infringed than the equal rights of their brothers. We held in *Lochner* v. *New York*, 198 U. S. 45, that a law providing that no laborer shall be required or permitted to work in bakeries more than sixty hours in a week or ten hours in a day was not as to men a legitimate exercise of the police power of the State, but an unreasonable, unnecessary, and arbitrary interference with the right and liberty of the individual to contract in relation to his labor, and as such was in conflict with, and void under, the Federal Constitution. That decision is invoked by plaintiff in error as decisive of the question before us. But this assumes that the difference between the sexes does not justify a different rule respecting a restriction of the hours of labor.

In patent cases counsel are apt to open the argument with a discussion of the state of the art. It may not be amiss, in the present case, before examining the constitutional question, to notice the course of legislation as well as expressions of opinion from other than judicial sources. In the brief filed by Mr. Louis D. Brandeis, for the defendant in error, is a very copious collection of all these matters, an epitome of which is found in the margin.*

* The following legislation of the States impose restriction in some form or another upon the hours of labor that may be required of women: Massachusetts, 1874, Rev. Laws 1902, chap. 106, sec. 24; Rhode Island, 1885, Acts and Resolves 1902, chap. 994, p. 73; Louisiana, 1886, Rev. Laws 1904, vol. i, sec. 4, p. 989; Connecticut, 1887, Gen. Stat. revision 1902, sec. 4691; Maine, 1887, Rev. Stat. 1903, chap. 40, sec. 48; New Hampshire, 1887, Laws 1907, chap. 94, p. 95; Maryland, 1888, Pub. Gen. Laws 1903, art. 100, sec. 1; Virginia, 1890, Code 1904, tit. 51 a, chap. 178 a, sec. 3657 b; Pennsylvania, 1897, Laws 1905, No. 226, p. 352; New York, 1899, Laws 1907, chap. 507, sec. 77, subdiv. 3, p. 1078; Nebraska, 1899, Comp. Stat. 1905, sec. 7955, p. 1986; Washington, Stat. 1901, chap. 68, sec. 1, p. 118; Colorado, Acts 1903, chap. 138, sec. 3, p. 310; New Jersey, 1892, Gen. Stat. 1895, p. 2350, secs. 66 and 67; Oklahoma, 1890, Rev. Stat. 1903, chap. 25, art. 58, sec. 729; North Dakota, 1877, Rev. Code

While there have been but few decisions bearing directly upon the question, the following sustain the constitutionality of such legislation: *Commonwealth* v. *Hamilton Mfg. Co.*, 125 Mass. 383; *Wenham* v. *State*, 65 Neb. 394, 400, 406; *State* v. *Buchanan*, 29 Wash. 602; *Commonwealth* v. *Beatty*, 15 Pa. Sup. Ct. 5, 17; against them in the case of *Ritchie* v. *People*, 155 Ill. 98.

The legislation and opinions referred to in the margin may not be, technically speaking, authorities, and in them is little or no discussion of the constitutional question presented to us for determination, yet they are significant of a widespread belief that woman's physical structure, and the functions she performs in consequence thereof, justify special legislation restricting or qualifying the conditions under which she should be permitted to toil. Constitutional questions, it is true, are not settled by even a consensus of present public opinion, for it is the peculiar value of a written constitution that it places in unchanging form limitations upon legislative action, and thus gives a permanence and stability to popular government which otherwise would be lacking. At the same time, when a question of fact is debated and debatable, and the extent to which a special constitutional limitation goes is affected by the truth in respect to that fact, a widespread and long continued belief con-

(Penal Code, sec. 764), p. 1185; Wisconsin, 1867, Code 1898, sec. 1728, South Carolina, Acts 1907, No. 233.

In foreign legislation Mr. Brandeis calls attention to these statutes: Great Britain, 1844, Law 1901, 1 Edw. VII, chap. 22; France, 1848, Act Nov. 2, 1892, and March 30, 1900; Switzerland, Canton of Glarus, 1848. Federal Law 1877, art. 2, sec. 1; Austria, 1855, Acts 1897, art. 96 a, secs. 1 to 3; Holland 1889, art. 5, sec. 1; Italy, June 19, 1902, art. 7; Germany, Laws 1891.

Then follow extracts from over ninety reports of committees, bureaus of statistics, commissioners of hygiene, inspectors of factories, both in this country and in Europe, to the effect that long hours of labor are dangerous for women, primarily because of their special physical organization. The matter is discussed in these reports in different aspects, but all agree as to the danger. It would of course take too much space to give these reports in detail. Following them are extracts from similar reports discussing the general benefits of short hours from an economic aspect of the question. In many of these reports individual instances are given tending to support the general conclusion. Perhaps the general scope and character of all these reports may be summed up in what an inspector for Hanover says: "The reasons for the reduction of the working day to ten hours—(a) the physical organization of woman, (b) her maternal functions, (c) the rearing and education of the children, (d) the maintenance of the home—are all so important and so far-reaching that the need for such reduction need hardly be discussed."

cerning it is worthy of consideration. We take judicial cognizance of all matters of general knowledge.

It is undoubtedly true, as more than once declared by this court, that the general right to contract in relation to one's business is part of the liberty of the individual, protected by the Fourteenth Amendment to the Federal Constitution; yet it is equally well settled that this liberty is not absolute and extending to all contracts, and that a State may, without conflicting with the provisions of the Fourteenth Amendment, restrict in many respects the individual's power of contract. Without stopping to discuss at length the extent to which a State may act in this respect, we refer to the following cases in which the question has been considered: *Allgeyer* v. *Louisiana*, 165 U. S. 578; *Holden* v. *Hardy*, 169 U. S. 366; *Lochner* v. *New York*, *supra*.

That woman's physical structure and the performance of maternal functions place her at a disadvantage in the struggle for subsistence is obvious. This is especially true when the burdens of motherhood are upon her. Even when they are not, by abundant testimony of the medical fraternity continuance for a long time on her feet at work, repeating this from day to day, tends to injurious effects upon the body, and as healthy mothers are essential to vigorous offspring, the physical wellbeing of woman becomes an object of public interest and care in order to preserve the strength and vigor of the race.

Still again, history discloses the fact that woman has always been dependent upon man. He established his control at the outset by superior physical strength, and this control in various forms, with diminishing intensity, has continued to the present. As minors, though not to the same extent, she has been looked upon in the courts as needing especial care that her rights may be preserved. Education was long denied her, and while now the doors of the school-room are opened and her opportunities for acquiring knowledge are great, yet even with that and the consequent increase of capacity for business affairs it is still true that in the struggle for subsistence she is not an equal competitor with her brother. Though limitations upon personal and contractual rights may be removed by legislation, there is that in her disposition and habits of life which will operate against a full assertion of those rights. She will still be where some legislation to protect her seems necessary to

secure a real equality of right. Doubtless there are individual exceptions, and there are many respects in which she has an advantage over him; but looking at it from the viewpoint of the effort to maintain an independent position in life, she is not upon an equality. Differentiated by these matters from the other sex, she is properly placed in a class by herself, and legislation designed for her protection may be sustained, even when like legislation is not necessary for men and could not be sustained. It is impossible to close one's eyes to the fact that she still looks to her brother and depends upon him. Even though all restrictions on political, personal, and contractual rights were taken away, and she stood, so far as statutes are concerned, upon an absolutely equal plane with him, it would still be true that she is so constituted that she will rest upon and look to him for protection; that her physical structure and a proper discharge of her maternal functions—having in view not merely her own health, but the well-being of the race—justify legislation to protect her from the greed as well as the passion of man. The limitations which this statute places upon her contractual powers, upon her right to agree with her employer as to the time she shall labor, are not imposed solely for her benefit, but also largely for the benefit of all. Many words cannot make this plainer. The two sexes differ in structure of body, in the functions to be performed by each, in the amount of physical strength, in the capacity for long-continued labor, particularly when done standing, the influence of vigorous health upon the future well-being of the race, the self-reliance which enables one to assert full rights, and in the capacity to maintain the struggle for subsistence. This difference justifies a difference in legislation and upholds that which is designed to compensate for some of the burdens which rest upon her.

We have not referred in this discussion to the denial of the elective franchise in the State of Oregon, for while that may disclose a lack of political equality in all things with her brother, that is not of itself decisive. The reason runs deeper, and rests in the inherent difference between the two sexes, and in the different functions in life which they perform.

For these reasons, and without questioning in any respect the decision in *Lochner* v. *New York*, we are of the opinion that it

cannot be adjudged that the act in question is in conflict with the Federal Constitution, so far as it respects the work of a female in a laundry, and the judgment of the Supreme Court of Oregon is

Affirmed.

True Copy.

Test:

JAMES H. McKENNEY,
Clerk, Supreme Court, U. S.

INDEX

INDEX

ABBÉ, E.: efficiency and length of workday, 155, 163; the optimum of production, 165; working capacity and its adjustment to speed, 206; Zeiss Optical Works study, 155–167

ACCIDENTS, industrial, and their hours of incidence: activity rate, relation to, 78; *American Journal of Sociology*, 75; Belgian statistics, 74; cotton mills, 76, 77; earliest statistics as to hours of incidence, 72; factors, 78–79; fatigue, 71–72, 78–79; French factory statistics, 74; general manufacture, 76, 77; German statistics, 72–74; hours when most frequent, 73–76; Illinois accidents by hour of day, 75; Imbert, Prof., 74; Indiana, 76, 77; insurance statistics, 72–74; Italian railroad machine shops, 75; metal workers, 76, 77; need of scientific examination, 79; speed factor, 78–79; United States, 75, 76, 77; Wisconsin Bureau of Labor, 75, 76

ACIDITY OF FATIGUED MUSCLE, 25

ACT OF GOD, 202

American Journal of Sociology: industrial accidents, 75

AMERICAN TELEPHONE AND TELEGRAPH COMPANY, 49

ANABOLISM, 12, 21

ANIMALS: death from exhaustion, 13; measurement of muscular fatigue, 14–18

ANTI-TOXIN OF FATIGUE, 26, 27

ARSENAL, Watertown, 201–202

ART OF CUTTING METALS, 195

ASHLEY, LORD (Shaftesbury), 6, 72; argument against long hours, 128; leadership in legislation in 1844, 124, 129

ATLANTIC MILLS: Lawrence, Mass., 131–132

ATTENTION: definition, 68–69; effect of noise, 69; fatigue of, 69; fatigue in school children, 117

AUDITING: overtime, 87

AUGMENTATION OF WORKING POWER, 35–36, 38

AUSTRALIA: shorter hours, 167–168

AUSTRIAN SICKNESS INSURANCE SOCIETIES: morbidity, 42

AUTOMATIC ADAPTATION of worker to shorter hours, 163, 165

BAKERS' TEN-HOUR LAW, 246–247

BALTIMORE CANNERIES, 63

BARGAINING: collective, 208–210

BARTH, C. G., 197

BASKET MAKING: Delaware law, 187

BEELITZ SANITARIUM, 102, 103, 104, 105

BELGIUM. See *Engis Chemical Works*

BELL TELEPHONE COMPANY: Toronto controversy, 7, 48–49, 108

BELTING: maintenance, 207–208

BERLIN: Beelitz sanitarium, 102; factory inspectors' examination, 238; heart disease among working people, 105; labor conference, March, 1890, 261

BERNE INTERNATIONAL CONVENTION on Night Work, 248, 259–265; United States' position, 269

BETHLEHEM STEEL WORKS, 195–200

Biddeford, Maine: infant mortality, 91, 92

Binswanger, 103

Birds: exhaustion after flight, 31

Birth Rate, 95–96

Bituminous Coal Mining in United States: table of output, 170–172

Blood: effect of diminished circulation, 31; medium for carrying nutritive materials, 12, 23; medium for carrying chemical wastes, 12, 15, 17, 24

Bookbinding Trade: overtime, 84, 85, 271

Borderland of Illness, 108, 111

Box Making. See *Paper box making*

Boys: long hours still legal, 4; in rubber goods manufacturing, 234

Brandeis, L. D.: new defense of labor laws, 252; Oregon case, 251–252; scientific management, 192, 194

Breakdown: contributory causes, 278, 281; data lacking in United States, 100–101

Brewer, Justice, 255

Bricklaying: efficiency under scientific management, 193

Brickmaking, 145–146

Bright, John, 124–125, 129

British Admiralty, 142–143

British Association for the Advancement of Science: legislation and regularity of work, 184; opinion on regulation of hours, 128

British Factory Inspectors: first appointment, 129; on overtime, 88–89; providing information, 130, 229

British Government and the Eight-hour Day, 141–142

British Interdepartmental Committee on Physical Degeneration, 113

British War Office, 141–142

Broggi, U.: fecundity of working women, 96

Burckhardt, A. E.: morbidity of women, 40–41

Bureau of Arbitration. See *New York State Department of Labor*

Caisson Work, 120

California: canneries, 63, 186; unjustified overtime in canneries, 187

Canneries: California, 63; California, lack of records, 186; California overtime, 187; capping, 61–63; constrained attitudes, 61–62; Delaware law, 187; disorganization of the labor force, 185–186; feeding corn cutters, 62; general description, 60; machinery, 60; Maryland, 63, 185; New York state, 60–62; overtime, 185; season, 62–63; sorting, 60–61; special overtime privileges, 269; state legislation, 223

Carbon Dioxide, 22, 23–24, 25, 265

Carl Zeiss Foundation, 156, 157

Carozzi, L.: night workers in Italy, 266

Carrier Pigeons: exhaustion in, 31

Catabolism, 12, 21

Cell: distinctive property, 11

Change: of habits in purchasing, 180–182; in fashions, 189; of work, value, 107

Chemical Workers, 144–155

Chemistry: of fatigue, 12, 13; of muscular contraction, 21–25

Child Labor, 232; inspection of health, 235; validity of New York law, 250

Children's Employment Commission, 127

Christmas Trade: auditing, 87; Consumers' League work, 183; exemptions in state laws, 223; hours unlimited in New York, 4; overtime, 84, 87

Civil Service Examination for inspectors, 237
Civil War Veterans as inspectors, 237
Class Legislation, 257–258
Closing Hour: fixed, 211, 214, 216, 217, 224–225, 226, 261, 277
Cloth Folding: efficiency under scientific management, 193
Coal Mining: machinery, 171–172; results of shorter hours, 169–172
Coal Shoveling: efficiency under scientific management, 142
Cobden, 124, 128
Colorado Manufacturers' Association, 123
Committee of One Hundred on National Health, 115
Commons, J. R.: Organized labor and efficiency, 208–210
Complexity of Industry. See *Speed in manufacture*
Compositors: Pieraccini's study, 134–136
Concentration of Work, 59
Consciousness of Fatigue, 38
Conservation of Human Energies, 286
Constitution: United States, 243–244
Constitutionality of Laws, 242
Consumers: policy of persuasion, 182–184
Consumers' League, 181, 183, 184; court decisions, 250
Contract: freedom of, 243–244
Contraction: muscular, chemistry of, 21–25; study of, 14–20
Cooley's Constitutional Limitations, 258
Cotton Goods Manufacture: efficiency under scientific management, 193
Cotton Mills: night work of women and children in North and South Carolina, 273–276; scientific management and women workers, 205; study of
Cotton Mills (*Continued*) children in, 232; weaving room study, 201, 204
Court Decisions: as to constitutionality of state labor laws, etc., 231–232; Consumers' League and, 250; Holden vs. Hardy, 245–246; judicial cognizance of general knowledge, 252, 253; Lochner case, 246–247; Oregon case, 251–252; Ritchie case, first, 243–244; Ritchie case, second, 253; sex distinctions, 253–256; Williams case, 247–251
Courts: labor laws and, 242–258
Cranberries: Sunday picking, 188, 189
Curare: use in study of nervous fatigue, 30
Curve of Effort, 33
Curve of Fatigue, 20, 33, 35, 38, 134–136
Customers: adaptation to change, 180–182

Dancing: rhythmic element, 80
Degeneration. See *Race degeneration*
Delaware: canning law, 187
Denis, H.: right to rest, 39
Department Stores: shifting of employes, 206; states allowing exemptions at Christmas time, 223; states limiting hours for women, 5
Devine, Edward T.: minor ailments, importance, 116–117
Dextrose, 21, 22
Digestion, 283–284
Discrimination in the laws, 257
Disease: general predisposition among working people, 111–112
Diseases: industrial, 112–115; Milan clinic for industrial, 113; minor ailments, 115–117; occupational, 233–234; trade, 112, 115; white lead industry, 238
Domestic Duties: women's, 55, 267

Doubling up, 213, 214
Draper Looms: number tended, 56–58
Dressmaking: overtime, 176–177
Drive, 200, 206, 209

Early Closing Bill, 250
Economic Ruin: fear of, 121–122, 124
Efficiency, 156; Germany, 165–166; in administration of labor laws, 228; maximum of individuals, 165. See also *Fatigue; Output; Scientific management; Shorter hours*
Efficiency Engineers, 196–208
Effort: under fatigue, 33–34
Eight-hour Day: 141, 143; Australia, 167–168; bituminous coal mining in United States, 170–172; Engis chemical works, 144–154; Germany, 164; women, 169. See also *Shorter hours*
Eight-hour Law: first Ritchie case, Illinois, 243–244; Montana, 256; Pennsylvania, 256
Elastic Law: Great Britain, 218–223; United States, 223–227
Emergencies: overtime allowance for, 184–190
Emerson, H.: belting, 207–208
Employment: regularity of, 175–191
Enforcement of Labor Laws: annual report of labor departments, 228–229; desiderata, 211; elastic law, 218–227; Great Britain, 216–218; inspectors' difficulties, 226; inspectors' opinions on, 231; Massachusetts textile law, 212–216; non-textile acts, 218
Engis Chemical Works: reorganization and effect of reduced hours, 144–155
England: early factory legislation, 6; night work for women, 260; ten hours movement, 123–131. See also *Great Britain*
Epidemics: contribution of overfatigue, 111
Equalizing Seasons in Trade, 178–180
Ergograph, 18–20, 33–34
Eukles, 14
Evening Work. See *Overtime*
Exhaustion, 9, 23, 111, 114, 115, 281, 283–284; birds, 31
Eyeletting Shoes, 66
Eyes: strain on, 54, 61, 63, 109

Factory Inspectors: annual reports, 228–232; character and fitness, 236–238; England's first, 129; inspection of health, 233; New York state, 227; physicians as, 233; Prussian training, 238; past services, 129–130
Factory Legislation as to hours of work. See *Legislation*
Fall River, Massachusetts: infant mortality, 91, 92
Fashion: changes in, 189; changes work hardship to piece-workers, 83–84
Fatigue: accumulation of waste products, 11–14; accumulation in overtime, 87; anti-toxin of, 26, 27; as a danger of occupation, 118; consumption of energy-yielding substance, 20–25; curve of, 20; effect on digestion, 283–284; fundamental factors, 20, 21; individuality in, 19; in industry, need of new study, 117–120; International Congress of Hygiene, 113; Italian study of, 113–115; measurement of muscular fatigue, 14–20; nature of products, 25–27; nervous nature, 27–33; new study of, in industry, 112–115; normal and abnormal, 31; passive, 164; physiology of, 11–38; poison of, 13, 28, 36, 281; predisposition to disease in general, 111–112; present day relation to output, 133; rhythm of machinery an element, 79–82; specific toxin of,

FATIGUE (*Continued*)
26, 27. See also *Nervous fatigue; Output*
FISH-CURING in Great Britain, 220–221
FISHER, IRVING: overfatigue, 115
FITCH, JOHN A.: court decisions on hours of labor, 255; example of eight-hour day, 168
FLAX SCUTCH MILLS, 222
FLORENCE, Italy: compositors, 134–136; Dr. Giglioli, 114; Professor Pieraccini, 133
FOLKSONGS: rhythm, 80
FOSTER, SIR MICHAEL: nature of cellular life, 12; poisons of fatigue, 13
FOURTEENTH AMENDMENT to the Constitution of the United States, 243–244
FREEDOM: labor's, to contract, 243–244; restraint of, 242–243
FRENCH FACTORY INSPECTORS: on overwork and military service, 99
FREUND, ERNST: police power, 243
FROG: fatigue in muscle contraction, 14–18, 35
FROMONT, L. G.: reorganization of Engis works, 144–155
FRUIT-PRESERVING ESTABLISHMENTS in Great Britain, 220, 221

GANTT, H. G.: efficiency under scientific management, 200, 201, 205
GENERAL KNOWLEDGE: judicial cognizance of, 252, 253
GERMAN EMPEROR, 261
GERMAN INDUSTRIAL CODE, 263–264
GERMAN WORKINGMEN: fitness for military service, 99
GERMANY: economic efficiency, 165
GIBSON, M., 126
GIGLIOLI, G. Y.: pathology of labor, 114
GLASS WORKERS: moral degeneration, 275
GLYCOGEN: how supplied and consumed, 21–23
GRAHAM, J., 128
GREAT BRITAIN: elastic laws, 218–223; fish-curing, 220–221; flax scutch mills, 222; fruit-preserving, 220, 221; laundry legislation, 221–222; rigid law development, 216–218
GRIGG, W. C.: injury of long hours, 95–96
GUN CARRIAGES, 202
GÜTERGUTZ SANITARIUM, 102

HABITS: possibility of changing, 180–182
HALF-HOLIDAY, 225
HANSARD'S PARLIAMENTARY DEBATES, 124, 125
HARDY. See *Holden v. Hardy*
HARRISON, A. See *Hutchins, B. L.*
HEALTH: observation of, in industrial establishments, 233–236; minors, 234
HEART DISEASE: Berlin working people, 105
HELMHOLTZ, H. VON: myograph and frog experiments, 17
HENDERSON, C. R.: European industrial insurance, 101
HIPPS' CHRONOMETER, 69
HISTORY OF FACTORY LEGISLATION: the standard, 123
HOLDEN V. HARDY, 245–246
HOLLAND: night work for women in laundries, 268
HOSPITALS: as sources for study of industrial fatigue, 118–119; value of cases and records, 120
HOURS OF THE DAY when accidents occur. See *Accidents*
HOURS OF LABOR: laws regulating, 291–304
HUMAN ELEMENT IN WORK, 127, 137, 140, 141
HUME, 124, 127
HUTCHINS, B. L.: legislators' ignorance of industrial experience, 123

ILLINOIS: bituminous coal-mining, 171–172; Manufacturers' Association, 122–123; ten-hour law, 180, 253
State Department of Factory Inspection: accidents by hour of day, 75
Supreme Court: eight-hour law for women, 243–244; second Ritchie case, 253; ten-hour law decision, 1910, and its value, 4
IMBERT, PROFESSOR: accidents, 74
IMMIGRATION, 286
INCIDENCE OF ACCIDENTS. See *Accidents*
INDIANA: accident statistics, 76, 77
INDIVIDUALITY: in fatigue, 20, 137
INDUSTRIAL ACCIDENTS. See *Accidents*
INDUSTRIAL COMMISSION, Wisconsin, 239–240
INDUSTRIALISM: English beginnings, 124, 125
INDUSTRIAL RUIN: cry of, 121–122, 124
INFANT MORTALITY: cotton mill towns, 91; factors, 91; Great Britain, textile and non-textile towns, 92–94; United States, 91–92
INSPECTORS. See *Factory inspectors*
INSURANCE SOCIETIES. See *Sickness insurance societies*
INTERNATIONAL ASSOCIATION FOR LABOR LEGISLATION, 261
INTERNATIONAL COMMISSION ON TRADE DISEASES, 114
INTERNATIONAL CONFERENCE ON LABOR, 261
INTERNATIONAL CONGRESS OF HYGIENE, 113, 260
INTERSTATE COMMERCE COMMISSION, 192, 208
IRON AND STEEL INDUSTRY: long hours of workers in the United States, 4
IRREGULARITY OF EMPLOYMENT: injurious effect, 110, 175, 176, 191
ITALIAN JOURNAL OF SOCIAL MEDICINE, 114
ITALIANS: prominent place in study of fatigue, 113–115

JAMES, WM.: effect of noise on reaction time, 69–70; second wind, 282
JANUARY "WHITE SALE," 178
JAY, RAOUL, 259
JENA, Germany: Zeiss Optical Works, 155–167
JEWELRY CASE and box making, 180

KEARSLEY, England: death rate, 94
KENNEDY, J. L., 127
KENTUCKY: commission on working women, 50

LABOR BUREAUS: annual report, value, 228–232; lateness of reports, 229–230
LABOR LAWS. See *Enforcement of labor laws; Legislation*
LABOR LEGISLATION. See *Legislation*
LABOR: organized, attitude toward scientific management, 208–210
LANCASHIRE, England: cotton spinners' position, 218; death rate, 94; factory conditions early in the nineteenth century, 6; long hours and output, 127
LAST HOURS OF WORK, 126
LAUNDRIES: British legislation, 221–222; intemperance, 280; night work in Holland, 268; Oregon case, 251–252; overtime and irregularity, 181; overtime in New York City, 271–272
LAUNDRYMEN'S ASSOCIATIONS, 122, 123
LAWRENCE, Massachusetts: Atlantic mills, reduced hours, 131–132; infant mortality, 92
LAWS, LABOR: constitutionality, 242; courts and, 242–258; discrimination, 257–258; first Ritchie case, 243–244; freedom of contract theory, 243–244; Holden v. Hardy, 245–246; Lochner case, 246–247; new de-

LAWS, LABOR (*Continued*)
fense by Brandeis, L. D., 251–252; Oregon case, 251–252; police power, 242–243; regulating hours of women's labor, 291–304; second Ritchie case, 253; sex distinctions, 253–256; validity, 256–258; Williams case, 247–251. See also *Enforcement of labor laws; Legislation; Statutes*

LEAGUE. See *Consumers' League*

LEE, FREDERIC S.: fatigue, 17, 19, 25, 32, 281

LEGISLATION: aim, 6; a new basis, 3, 9; benefits, 128, 130, 132–133; class, 257–258; closing hour, 211, 214, 216, 217, 224–225, 226, 270, 277; converts in England, 128–129; England, early, 6; inspector's record of effects, 130; Massachusetts, 131–132, 212–216; need, 182, 184; non-textile, 218; organizations and associations opposing, 122–123; part played by factory inspectors, 129; physicians' testimony in England, 6; rigid law, development in Massachusetts, 212–216, in Great Britain, 216–218; similarity of history, 121–123; source of opposition to, 5–6, 121–122, 124; United States, inclusive of all manufacture, 224; women's rights party's position, 254; Wright, C. D., 131. See also *Enforcement of Labor Laws; Laws*

LEGISLATURES: freedom of, 257–258

LEIPZIG: sickness insurance society, 112

LEISURE: effect on working people, 278–280

LIBERTY. See *Freedom*

LIÉGE. See *Engis Chemical Works*

LIGHTING OF WORKROOMS, 239

LIMBERING-UP, 36, 78, 136

LIMITATION OF HOURS: physiological necessity, 9

LIVER: function, 22, 23

LOADING CARS: efficiency under scientific management, 193, 195–196

LOCHNER CASE, 246–247

LONG HOURS: Griggs, W. C., 95–96; in continuous industries for men, 256; iron and steel workers, 4; physicians' and medical schools' neglect of, 117; profits and, 130

LOOMS: number tended, 56–57

LÖWENFELD, 103

LUBBOCK, SIR JOHN, 250

LÜBENAU, DR., 104–105, 284

MACHINERY: coal mining, 171–172; fatiguing effect, 68–69; inventions and improvements, 172–173; manufacture, efficiency under scientific management, 193; shoe making, 64

MACHINE SHOP WORK: efficiency under scientific management, 193

MAGGIORA, A.: amount of rest after fatigue, 33–34, 88

MAHAIM, E.: results of eight-hour day in Belgium, 146

MANAGEMENT. See *Scientific management*

MANCHESTER, England: Salford experiment, 138–143

MANCHESTER SCHOOL, 124–125

MARTINEAU, H., 97

MARYLAND: canneries, 63, 186

MASSACHUSETTS: first official returns on occupational diseases, 233; history of rigid law, 212–216; legislation and output, 131–132; state inspector of health, 233
Bureau of Statistics of Labor; shorter hours and output, 131
General Hospital, 120
Supreme Court: cranberry-picking, 188

MATHER AND PLATT: experiment in shortening hours, 138–143

MEDICAL INSPECTION. See *Physicians*

METABOLISM, 12

MICHIGAN ten-hour law for women, 257–258

MIDVALE STEEL WORKS, 196

MILAN: clinic for industrial diseases, 113

MILITARY RECRUITING: testimony as to race degeneration, 97–98

MINES AND SMELTERS, 245

MINING: eight-hour laws, 254; Montana law, 256; Pennsylvania law, 256

MINOR AILMENTS: importance, 116–117

MINORS: employment in Massachusetts, 234; inspecting, 235; manufactures injurious to the health of, 234

MONOTONY: canneries, 59–64; effects, 106–107; industrial tendency, 285–286; light and easy work, 68; manufacturing hinges, 64; means of relief, 67; packing small wares, 66–67; paper boxes, 63–64; physiological basis, 67–68; shoe making, 64–67

MORALITY: danger of night work, 267, 275–276

MORBIDITY OF WOMEN: greater than men's, 39–42; statistics, 40–42

MOSSO, A.: effect of noise on reaction time, 69; ergograph, 18; exhaustion of birds, 31; fatigue studies in man, 16, 18–20; fatigued dog experiment, 15; ponometer, 33; recuperative effect of rest, 34; Sicilian sulphur workers, 98

MOTOR END-PLATE, 31

MUSCULAR CONTRACTION: chemistry of, 21–25

MUSCULAR FATIGUE: nature, measurement, 14–21

MYOGRAPH, 17

NATIONAL CONSERVATION COMMISSION, 115

NEEDLE TRADES. See *Sewing*

NERVE FIBERS: two groups, 29; unfatiguable, 29, 30

NERVOUS DISEASES: contributing causes, 106–107; German sanitaria, statistics, 103–106; increase, 103–110; Lübenau, Dr., 104–105; Roth, E., 105, 106–107; St. Louis garment workers, 110; telephone strain, 108–110; Treves, Z., 107–108, 111

NERVOUS ENERGY: effect of training on, 37; form of electric activity, 27

NERVOUS FATIGUE: consciousness of, 38; destructiveness, 27, 32; double origin, 28; location, 29–33; Maggiora, A., 28; Mosso, A., 28; nature of nerve impulse, 27; over-stimulation, 38; relation to muscular fatigue, 27, 28; unsettled problems, 32

NERVOUS SYSTEM: description, 28–29

NEURASTHENIA. See *Nervous diseases; Nervous fatigue*

NEWMAN, G.: infant death rate and women in industry in Great Britain, 92–94

NEW YORK CITY: bindery overtime, 85, 271; Christmas rush and Consumers' League, 183; overtime in laundries, 271–272; retail Dry Goods Merchants' Association, 123; working girls, 54–56

NEW YORK MERCANTILE INSPECTOR, 226

NEW YORK STATE: bakers' ten-hour law, 246–247; factory inspectors graded, 237; factory law, 226–227; medical inspector of factories, 233

Court of Appeals, 247, 248, 250, 251, 254, 259, 269

Department of Labor, 255; laundries, 271–272

NIGHT WORK FOR WOMEN: Berne convention, 259–265; binderies in New York City, 271; Carolina cotton mills, 273–276; Carozzi, L., 266; Delaware, 270–271; Dutch factory inspectors' account, 268; efficiency reduced, 268, 276; England, 260; exceptions provided

NIGHT WORK FOR WOMEN: (*Continued*)
at Berne, 262; extent, 271; first court decision, 248; France, 266; Georgia mill, 276; Germany, 266; glass making, 275; Holland, 268; inferiority of output, 267–268, 276; injurious effects, 86, 265–269; International Association for Labor Legislation, 261; International Conference on Labor, 261; International Congress of Hygiene, etc., 260; Italy, 266; laundries in New York City, 271–272; laws in United States, 248, 259, 304; moral injury, 86, 267, 275–276; prohibition a benefit, 259–269; public indifference, 269–271; Schuler, F., 260; silk weaving, 276; Switzerland, 260; telephone service, 272–273; United States, 269–277; Wisconsin legislation, 269–270

NOISE: canning, 62; effect on reaction time, 69; getting used to, 71; machines, effect of, 68–69; Mosso, A., 69; sewing machines, 54

NON-TEXTILE LEGISLATION, 218

NORMAL DAY, 183, 217, 222

NORTH CAROLINA: cotton mills, night work, 273–276

NORTHRUP LOOMS, 57

OBSERVATION OF HEALTH in industrial establishments, 233–236

OCCUPATIONAL DISEASES. See *Diseases, industrial*

OLIVER, SIR T.: beer in laundries, 280; industrial poisoning, Scotland, 143

OPTIMUM, 198, 206, 282

ORDERS: customers' adaptation in giving, 180–182; refusing, 190

OREGON TEN-HOUR LAW, 123, 231, 251–252; Supreme Court decision, 320

ORGANIZED LABOR. See *Labor*

OUTPUT: Ashley, Lord, 128; British Association for the Advancement of Science, 128; British government, 141–143; cash relation to fatigue, 137–138, 143; coal mining in United States, 170–172; effect of regulation of hours on wages, 173–174; England, 123–131; Engis Chemical Works, Belgium, 144–155; examples of extraordinary increase, 193; increase with shorter hours, 139, 149, 159; inferiority of night work, 267–268, 276; laboratory study, value, 121; Massachusetts Bureau of Statistics of Labor, 131; Pieraccini, G., 133–137; profit by regulation, 130; relation between long hours and spoiled work, 128; relation to fatigue, 123–133; Salford Iron Works, 138–143; United States' experience in regulation of hours, 131–133; Zeiss Optical Works, 155–167

OVERFATIGUE, 9; Fisher, I., 115; physicians' neglect to study, 117; public and social menace, 111; society's failure to appreciate, 117

OVERPRODUCTION, 190

OVERSTIMULATION: deceptive nature of, 38

OVERTIME: ailments after, 88; allowances and exemptions, 213–214, 219, 302, 303; basis for, 177–178; British Association for the Advancement of Science, 184; British factory inspectors, 88–89; British tobacco factories, 88; canneries, 185–186; Chicago, 85–86; cranberry-picking, 188–199; deterioration of product, 163; economic evils, 176–177; emergencies, 184–190; essential injury to health, 86–87; evil effect of allowing, 185, 191; extent, 271; extreme forms, 84; Federal investigation, 85; frequency, 85; gradual restriction in Great Britain, 219–223; key to regulation of hours, 211; laundries, 180–182; legal clos-

Overtime (*Continued*)
ing hour, 211; legal prohibition, 184–191; likenesses to the long day, 176; minors in Great Britain, 223; necessity for, 188–189, 191; New York City, 85; night dangers, 86; paper-box making, 85–86; physiological evils, 176; power of persuasion, 182–184; regularity and, 175–191; Roth, E., 89; telephone service in, 49–51; variation in different establishments, 190

Overtraining, 37

Overwork: new medical study of, 112–115; school children, 117; to check, 6

Owen, Robert: argument against long hours, 128

Oxygen: for combustion, 21; how supplied for muscular contraction, 23–25

Pace-makers, 83

Paper-box Making, 180; Chicago hours, 85–86

Parliamentary Debates, 124, 125

Passive Fatigue, 164

Pathology of Work, 113–115, 120

Peckham, Justice, 247

Pennsylvania: labor official, 231–232

Perishable Goods, 187, 220–223

Persuasion by Consumers, 182–184

Pettenkofer, 24

Physicians: as health inspectors in industrial establishments, 233; neglect of industrial overstrain, 117; nervous diseases, testimony as to increase, 103–110; testimony, 6, 7, 48

Piece-work: abuses, 82–83; as affected by shorter hours, 140; danger, 84; excessive strain, 107; fashion changes, 83–84; hardships, 83; merit, 82; pace-makers, 83; St. Louis garment workers, 110; sewing trades, 82; shoe industry, 82; speeding up, 82; statistics before and after reduced hours in Zeiss works, 157–162

Piece-work (*Continued*)

Pieraccini, G.: output study and its value, 133–135

Pig Iron Handling, 195–199

Poison of Fatigue. See *Fatigue, Toxin*

Police Power of the State, 242–243

Ponometer, 33

Ponometric Curve, 33

Postponement of Rest, 88

Preston, England: infant death rate, 94

Prevention of Disease, 102–103, 115, 118–119, 239

Prinzing, F., 42

Products of Fatigue: nature, 25–27

Prohibition: of night work for women, 259–269; of overtime, 184–191

Prussian: factory inspectors' training, 238

Purchasers: adaptation to change, 180–182

Quail: exhaustion after long flight, 31

Race Degeneration, 113; Ascher, Dr., 99; England, 1830–1840, 97; factory population, 97; France, 99; German workingmen, 99; military statistics, 97–98; Mosso, A., 98; Schuler, F., 98; sub-normal children, 97; Switzerland, 98–99

Ramazzini, B., 112

Ramazzini, Il, 114

Ranke, J.: experiment with fatigued frog muscle, 14–15

Reaction Time: individual differences, 69

REGULARITY OF EMPLOYMENT, 175–191; best incentive, 191; promoted by law, 182, 184; two examples, 179–180

REGULATION: basis of opposition to, 121–122, 124; effect on wages, 173–174; English conversions to the principle, 128–129; United States experience, 131–133

REST: balancing exertion, 12, 34, 38, 197; daily need, 256; essential value, 88; weekly, 256

RESTING TIME: telephone service, 110

RETAIL DRY GOODS MERCHANTS' Association of New York City, 123

RHYTHM: an element in fatigue, 79–82; dance and song, 80; human, 80; machinery, 81–82; physiology of, 81; value, 80–91

RIGID LAW: effect, 217; Great Britain, 216–218; Massachusetts, 212–216

RITCHIE CASE: first, 244–245; second, 253

ROEBUCK, MR., 128–129

ROTH, E.: nervous diseases among working people, 105, 106–107; overtime, 89

ROYAL CANADIAN COMMISSION, 7, 48–49

RUBBER GOODS MANUFACTURE, 234

SADLER'S COMMITTEE, 6

SAFETY: problems, 239

ST. LOUIS JEWISH DISPENSARY: neurasthenia among garment workers, 110

SALFORD IRON WORKS: economic results of shorter hours, 138–143

SANITARIA FOR WORKING PEOPLE in Germany, 102

SCHEDULES, COMPARATIVE: showing women's hours of labor, 291–304

SCHOOL CHILDREN: overwork and fatigue, 117

SCHULER, F.: morbidity of women, 40–41; night work law, 260

SCHWAB, C. M., 200

SCHWAB, DR. S. I., 110

SCIENTIFIC MANAGEMENT: Abbé, E. 206; benefits, 201–203; Bethlehem Steel Works, 195–200; charges against, 200; collective bargaining, 208–210; dangers, 200, 203–208; definition, 192; difference from ordinary, 194; effect on workers, 204–208; Emerson, H., 207–208; examples of increased efficiency, 193; Gantt, H. G., 200, 201, 205; loading a freight car, 195–196; need of study, 206; organized labor, 208–210; physical surroundings of workers, 203; speed, 199–200; stimuli, 194, 198–199; Taylor, F. W., 195; tiring effects of heavy labor, 196; training a worker, 197; Watertown (Mass.) Arsenal, 201–202; weaving, 201; women workers, 205; workers, effect on, 204–208; working capacity, 204; Wyatt, E., 205

SEASONAL TRADES: canning, 62; shoes, 179–180

SEASONS: efforts to equalize, 178–180

SECOND WIND, 282

SENIOR, N. W.: theory of last hours of work, 126, 127

SEWING INDUSTRIES: evils, 54–55; irregularity, 54–55; legal hours, New York, 54; long hours, 55; pay, 54–55; speed and strain, 53–56

SEWING MACHINES: increasing speed and strain, 10–11, 54

SEX DISTINCTIONS, 253–256

SEX FUNCTION OF WOMEN, 40

SHAFTESBURY, LORD. See *Ashley, Lord*

SHOE MANUFACTURING: equalizing seasons, 179–180; eyeletting, 66; machinery, 64; monotony, 64; piece-work, 82; subdivision of labor, 64; United States Industrial Commission, 64; upper trimming machine 65

SHORTER HOURS: Australia, 167–168; automatic adaptation, 163, 165; Belgium, 144–154; Denis, H., 39; diagram of health improvement, 151–155; economic benefits, 122; effect on piecework, 140; Engis Chemical Works, 144–155; England, 138–143; Germany, 155–167; increase of output, 139, 151, 158–159; market value, 143; men's, 168–169; purpose, 287; Salford experiment, 138–143; scientific basis, 38–39; slow movement toward, 168; temperance, 279–280; United States, 167–174; United States coal mining, 170–172; United States Industrial Commission, 169; United States lack of data, 167; uses of leisure, 279; various industries, 167, 169; women's, 168–169

SICILIAN SULPHUR WORKERS, 98

SICKNESS INSURANCE SOCIETIES: an American study of, 106; commonest diseases, 103; duration of illness, 41–42; German system and its opportunities for study of workingmen, 101–102; Leipzig, 112; morbidity statistics, 41–42; preventive treatment, 102; trade diseases, 112

SLEEP: loss of, 265–267

SOUTH CAROLINA: cotton mills, night work, 273–276

SPEED IN MANUFACTURE: American, 286, 287; gain of, 199–200; how gained, 59; increase, 10–11; sewing, 53–56; telephone service, 43–53; textile industry, 56–58

SPEEDING-UP, 193, 199; sewing trades, etc., 82

SPOILED WORK, 176; in twelve-hour day and afterward, 127–128

STANDING: injury to women, 95

STATE'S NEED OF PRESERVING HEALTH, 286–287

STATUTES REGULATING WOMEN'S HOURS OF LABOR: extracts from, 305–319

STEEL INDUSTRY. See *Iron and steel industry*

STITCHING TRADES. See *Sewing*

STOP-WATCH, 138, 192, 196, 200, 208

STRAIN, 34; new industrial, 43–89; scientific management, 204–208; three ways of reacting, 91; U. S. lack of data, 100–101

SUBDIVISION OF LABOR: shoemaking, 64, 65, 66

SULPHUR WORKERS, 98

SULPHURIC ACID, 144

SUNDAY: cranberry picking, 188–189; telephone service, 51

SUNDAY LAWS: courts and, 256

SUNSHINE: lack of, 265–266

SUPREME COURT: decision in Muller v. Oregon, 320

SURMENAGE, 115, 145

SWITZERLAND:
Factory workers: morbidity of women, 40; unfitness for military service, 98–99
Federal Council, 262, 263
Mutual insurance societies: morbidity, 41–42

TAYLOR, F. W.: scientific management, 195–200

TELEGRAPHERS: interstate railroad, 254, 256

TELEPHONE SERVICE: American Telephone and Telegraph Company, 49; Bell Company of Canada, 48–49; breaking point, 52; cities of excess calls, table, 53; excess loading, 52; exchange, 45–47; hardships, 49–52; hours, Toronto, 48–49; hours, United States, 49–51; Kentucky, 50; length of service, 273; nervous exhaustion, 108–110; New York, 49, 51; night work, 272–273; operating, 45–48; overtime, 49–51; physical effects, 48; resting periods, 51–52; Sunday work, 51; switchboard, 45–46; Toronto, Canada, 48–49; United States, 49–51; United States Bureau of Labor, 49

TEMPERANCE: effect of leisure, 279–280; growth with shorter hours of work, 154

TEN-HOURS MOVEMENT IN ENGLAND, 123–131; effect in Europe, 166; English opposition, 124, 125

TEXTILE INDUSTRY: Draper looms, 56–58; Great Britain, infant death rate, 92–94; looms tended, 56–57; Northrup looms, 57; speed and complexity, 56–58

TEXTILE LAW: Great Britain, 216–218; Massachusetts, 212–216

TIRING EFFECTS OF HEAVY LABOR, 196–199

TOBACCO FACTORIES: ailments after overtime, 88

TORONTO, CANADA: Asylum, 109; Bell Telephone controversy, 7, 48–49; physicians on telephone strain, 108–110; telephone report, 108

TOXIN OF FATIGUE, 13, 26, 27, 281

TRADE DISEASES: special, 112–115

TRADES: dangerousness, 120

TRADE UNIONS: basis in collective bargaining, 208–209; physical condition of members, 100

TRAINING: cost, 37; limits, 37; nature, 35–39; nervous and muscular strength, 37; overtraining, 37; physiological basis, 36; Treves, Z., 37; value, 36

TREPPE, 35, 134–136

TREVES, Z.: injury of excessive drain of energy, 35; overstrain among working people, 107–108, 111

TURIN SCHOOL, 19, 33

TWELVE-HOUR DAY, 4, 126, 256

UNCONSCIOUSNESS OF FATIGUE, 38

UNIFORMITY OF HOURS: need, 184; promoted by law, 182, 184

UNION LABOR. See *Labor*

UNITED STATES: administration of labor laws, 228; elastic law, 223–227; inclusiveness of legislation, 224; trend toward shorter hours, 167–174

UNITED STATES BUREAU OF LABOR: inquiry as to eight-hour day in Salford Iron Works, 141; telephone hours of service, 49

UNITED STATES INDUSTRIAL COMMISSION: on advantages of reduced hours, 169–170; shoemaking, 64

UNITED STATES SUPREME COURT: Holden v. Hardy, 245–246; Lochner case, 246–247; Oregon case, 231, 251–252

UTAH: eight-hour law for men in mines and smelters, 245

VAN THIENEN, T. H.: night Dutch work, 268

VIENNA, 260

VITALITY: national, 115

VOIT, 24

WAGE-EARNERS: value of study of diseases, 120

WAGES: effect of reduced hours on, 173–174; loss by delays and waiting, 203

WASHINGTON, D. C.: International Congress of Hygiene, etc., 26

WASTE: accumulation in the blood, 11–14, 18

WATERTOWN, MASS.: Arsenal, 201–202

WEAVING: efficiency under scientific management, 201, 204

WEBB, S.: effect of rigid law, 218; factory legislation, 123; textile and non-textile laws, 222

WEEKLY REST, 256

WEICHARDT, W.: toxin of fatigue, 25–26

WHITE LEAD INDUSTRY, 238

WILLIAMS CASE, 247–251

WISCONSIN: industrial commission, 239–240; limiting women's working hours, 269–270; night work for women, 270

WISCONSIN BUREAU OF LABOR: accident statistics, 75, 76, 77

WOMEN: freedom of contract, 244–245, 248–252; health and citi-

WOMEN (*Continued*)
zenship, 254–255; morbidity, 39–42; night work, 224–225, 259–277, 304; physical differences, 39–40; scientific management, 205; state's duty to protect health, 254–255. See also *Night work for women*

WOMEN'S RIGHTS PARTY and factory legislation, 254

WOOLRICH ARSENAL, 141, 156

WORCESTER, MASS.: employes' health, 235

WORK: hours of, laws regulating, 291–304; human element, 127; individuality in, 285; pathology of, 113–115; rhythm, 79–82

WORKING CAPACITY: rise and fall, 33–39

WORKING UNDER FATIGUE: effort, 33–34

WRIGHT, C. D.: effect of the ten-hour law in Massachusetts, 131

WUNDT: shortening of reaction time, 69–71

WYATT, E.: scientific management and working women, 205

ZACHER, DR.: German industrial insurance, 101–102

ZEHLENDORF SANITARIUM, 105, 107

ZEISS OPTICAL WORKS: experiences of shorter hours, 155–167

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